

Re-vitalising Energy Transition in Touristic Islands

Pilot Descriptions and Results

Deliverable 3.2 - Public

Lead beneficiary: MAG

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History of Changes

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List of Acronyms

Acronym	Meaning	
AP	Action Plan	
АНР	Analytical Hierarchical Process	
BAU Business As Usual		
CA Consortium Agreement		
CoM Covenant of Mayors		
DHW Domestic Hot Water		
D3.1 GENERA deliverable on ET Monitoring tools description		
D4.1	GENERA deliverable on road-mapping needs and island-specific recipes	
EP	Energy Planning	
ET	Energy Transition	
EU	European Union	
EV	Electrical Vehicle	
GA	Grant Agreement	
LASM	Local Authorities Support Managers	
SCOP	Seasonal Coefficient Of Performance	
SE	Sustainable Scenario	
SECAP	Sustainable Energy and Climate Action Plan	
SEER	Seasonal Energy Efficiency Ratio	
SIMESEN	Simulation Energy Scenarios	
SMEs	Small and medium-sized enterprises	
UPV	Polytechnical University of Valencia	
WP	Work Package	



Executive Summary

This document has been developed as part of **LIFE21-CET-LOCAL-GENERA** project, funded by European Climate, Infrastructure and Environment Executive Agency - LIFE Project Grants, under **Grant Agreement No. 101077073**.

It corresponds to Work Package 3 (WP3) – *Energy Transition Monitoring Tools* and to Deliverable D3.2 – *Pilots Description and Results*. This deliverable includes the information gathered through the activities *T.3.5 Validation of the Monitoring tools: pilots and benchmarking*.

This document focuses on the validation of the tools created by the GENERA project to check that the Energy Transition package is operational and meets the requirements of the users. For this purpose, a pilot test will be carried out in different municipalities located in tourist islands mainly in the Mediterranean: Sant Antoni de Portmany (Ibiza, Spain), El Rosario (Tenerife, Spain), Stintino (Sardinia, Italy), Halki, Rhodes and Nisyros (Greece).

The GENERA tool consists of modules discussed in the deliverable *Deliverable D3.1* - *GENERA ET Monitoring tools description*: 1.National Energy Context Definition, 2.Knowledge Database, 3.Inference Module and 4.Multicriteria Decision Making Module. These tools together constitute the Energy Transition Package that will be used in this document to provide the information for the pilots.

This deliverable proposes updates and improvements to the tools that can be implemented in the future, as well as conclusions on the results obtained.



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1. Overview

1.1. Purpose and Scope

The main objective of this deliverable is to provide a report with the tools generated through the GENERA project, their application to different pilots and the results gathered through their application for the subsequent improvement of the tools for the Energy Transition.

Specific key objectives in GENERA include providing tools to identify the energy context of the islands at the national level and creating a municipal roadmap appropriate to the municipal casuistry of the islands. This deliverable is based on the information collected in WP2, WP3 and WP4 that has been processed together with a desk study and different meetings held with municipalities. All this has facilitated the implementation of the tool. The content of this report gathers specific information of task *T.3.5 Validation of the Monitoring tools: pilots and benchmarking*. The objective of this document is to show the application of the tools in the different pilots, and to serve as an example for future implementations.

1.2. Structure of the deliverable

The document is structured in four chapters in addition to this first one, which is the general overview:

Chapter 2 – Genera Tools updates

This chapter is focused on showing the main characteristics and specifications of the modules proposed by the GENERA project:

- 1 Definition of the National Energy Context
- 2 Knowledge Database
- 3 –Inference Module
- 4 Multicriteria Decision-making Module.

Chapter 3 - Pilots Results

Results of a total of six pilots: Sant Antoni de Portmany (Ibiza, Spain), El Rosario (Tenerife, Spain), Stintino (Sardinia, Italy), Halki, Rhodes and Nisyros (Greece).

Chapter 4 – Conclusions

This chapter highlights the main conclusions of this deliverable.



2. Genera Tools updates

According to GENERA's objectives, firstly, it aims to establish a framework of energy transition measures for the implementation of climate agendas in tourist municipalities, assisting them all the way from the creation of the agenda to the implementation of the measures and citizen engagement, in accordance with the Clean Energy Transition Agendas of the EU Islands and the Covenant of Mayors.

In addition, it is intended to promote the implementation of energy monitoring measures to quantify the evolution of the process. The methodology proposed by the GENERA project is as follows according to figure 1:



Figure 1. Methodology proposed by the GENERA project for the creation of a SECAP

In the previous deliverable D3.1 a first approach to the GENERA tools was made in order to create a specification sheet that included the necessary and required information for each of the modules. As the project has progressed, these tools have changed and have been modified to include new functionalities. However, these tools are subject to changes and improvements as long as they facilitate their use by policy makers, city council technicians and other interested parties who require their use.

2.1. Monitoring tools

The GENERA project has created an Energy Transition package (Figure 2) in line with its objectives and the needs identified throughout the project. It is important to have the voice of policy makers to ensure a coherent implementation of the measures, so the last module is an innovative point that will characterize the roadmap.



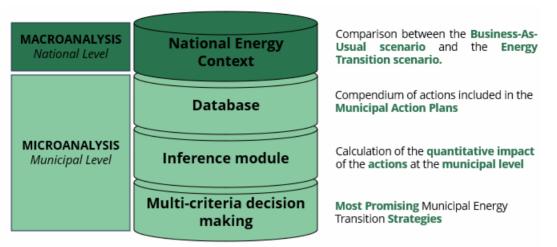


Figure 2. GENERA's Energy Transition Package

The following sections provide a brief overview of the different modules and their functionalities, as well as possible improvements within the energy transition package.

2.1.1. Energy Context Module

This module is designed for Energy Planning (EP) at the national level for the municipality under study, it aims to analyze the alternative ways of energy evolution through the study of different energy scenarios.

The SIMESEN tool (Simulation of Energy Scenarios) was developed at the <u>Institute of</u> <u>Energy Engineering</u> of the Polytechnic University of Valencia (UPV) in 2010 based on the evolution of independent variables that can be defined by predetermined mathematical law, and therefore, no major changes or relevant modifications have been made. This tool makes it possible to determine the evolution of a given energy scenario based on energy demand and the availability of primary energy, in order to subsequently deduce the role that renewable energies could play to make a sustainable scenario possible within a predetermined period of time.

2.1.2. Knowledge Database

This module consists of a repository of existing actions in Municipal Action Plans located on tourist islands in Greece, Italy and Spain. The main actions included in different municipal action plans of the islands were compiled together with the annual energy savings, the annual CO₂ emissions savings and the implementation cost per 1000 inhabitants.

The actions were grouped into the following sectors: awareness, industry, municipal buildings and equipment, and transport.

This repository was integrated into GENERA's Digital Social Platform to make it fully accessible to all public authorities and technicians of municipalities that require it. Therefore, the updates related to this module are presented in the following figures:





Figure 3. Access to the Energy Transition Tool: Database

	Energy Transition	
Awareness-raising	g Municipal Buildings and Equipment Transport	
Sector	Actions	
Awareness- raising	Communication, training and awareness-raising plan	
Awareness- raising	Energy-saving information programme for school institutions	
Awareness- raising	Campaign to promote sustainable mobility	
Awareness- raising	Promotion of walking and electric personal mobility vehicles (EVs)	
Awareness- raising	Municipal waste collection, recycling and composting network	
Awareness- raising	Rainwater harvesting and utilisation	
Awareness- raising	Campaign for waste reduction and correct waste management	

Figure 4. List of actions in the GENERA Database



Sector Transport		Action Promotion of public transport: inland public transport circuit and increased frequency
Number of Action Plans		
s 6- eld 4- voto V 2-	Spai Gree Italy	e -
Energy Savings 550 MWH/year	CO2 Savings	Cost

Figure 5. Information included within each action in the list of actions in the GENERA Database

2.1.3. Inference Module

This module provides the user with a calculation method to obtain the impact of the implementation of actions similar to those offered in the Knowledge Database in terms of energy and emissions, appropriate to the municipality. For this purpose, a method for calculating energy savings and emissions has been developed for each of the proposed actions. The actions have been organized according to the sections contained in the DataBase module, and some updates have been made with respect to the information that was included in the D3.1 report:

2.1.3.1. Section 1: Awareness-Raising

In this section, the same actions previously established are maintained:

- Installation of a municipal ecomovil
- Municipal information stands

These are the main actions that were proposed and have been implemented in the GENERA tool in the Inference module:

Co-knowd by the European Union	SECAPs MO	NITORING TOOL	UNIVERSIDAD POLITECNICA DE VALENCIA	Instituto Ingeniería Energética
Q A	AWAR	RENESS-RAISING		
DESCRIPTION: This section i	includes information and actions	related to recycling and environmental a	vareness of citizens.	
Ecomovil		Installation of ecomovils in municipali	ties to promote recycling	
Information stands		Different measures to promote enviro consumption at the municipal level	nmental awareness and	responsible

Figure 6. Actions implemented in the awareness-raising section of the toolkit



Following the calculation procedure discussed in report D3.1, the calculation of energy and CO_2 savings for each of the measures is shown below.

£3	Ecomovil		LOCATION CANARIAS
	Inhabitants		
[1] Number of inhabitants in the municipality	1520		
	km	Default Va	alue
[2] Increase in the Municipal Collection Waste (MSW) collection rate (%)		10%	
[3] Hours of service (days per year)	7		
[4] Recycled renewable fraction (kg)	337.117		
Energy saving (kWh	h/Year)	292.392	
CO2 emissions save	ed per year (kgCO2 eq)	233.914	2

Figure 7. Visualization of the tool implementing the calculation of the municipal ecomovil action.

		Information stands
\checkmark	Select the acti	tions you plan to implement in your municipality
		Аррју
1	Communication, training and a v areness-raising plan	×
2	Environmental school for school groups	×
3	Collection of special waste at Puntos Limpios (recycling centres)	×
4	Bonuses for self-consumption:	
	IBI (property and real estate tax)	0 ×
	ICIO (Construction and works tax)	0
	IAE (Business Activity Tax)	<u>a</u>
	Municipal Fees	s
5	Responsible energy consumption strategies	×
	Energy saving (k¥h/Year)	
	CO2 emissions saved per	r year (kgCO2 eq)

Figure 8. Visualization of the tool implementing the calculation of the information stand action



2.1.3.2. Section 2: Industry

In relation to the Industry section, different ways of promoting SMEs to achieve energy savings and efficiency are proposed, following the established in the D3.1 report, different ways and actions are proposed to encourage companies, and the corresponding energy savings that this entails.

The proposed incentive lines are maintained, being Change of energy vector, Improvement of industrial buildings, Improvement of processes and Renewal of equipment, according to the following figure:

SECAPS MO	SECAPS MONITORING TOOL				
	INDUSTRY				
DESCRIPTION: This section includes all industry-related actions and an housing and SMEs. This section has the aim of reducing final energy consu	incentive programme for energy saving and efficiency and the use of renewable energy in mption and CO2 emissions				
Process improvement	It focuses mainly on actions to improve energy metering and monitoring elements, as well as energy optimisation.				
Renewal of equipment	Replacement, renovation and improvement of process machinery with more energy- efficient ones.				
Industrial buildings	Improvement of insulation, renovation of installations, air-conditioning and lighting systems.				
Change of energy vector	Diversification of energy sources to less polluting ones and replacement of heating and pumping equipment with more efficient sources.				

Figure 9. Actions implemented in the Industry section of the toolkit

Following the technical guide for energy efficiency in industrial practice, the incentive lines to be applied for SMEs are selected and associated with energy and CO₂ savings.

Change of energy vector high efficiency LPG burnet direct air vein 20% 232600.00 f133.810834 121.47 Change of energy vector LPG burnet fider air vein 20% 232600.00 612.8116339 13.33 Change of energy vector LPG burnet fider air vein 20% 23260.00 612.8116339 13.33		Please select the ind	ustry line in whi	ch the measures aj	pply:	
Industrial buildings Process improvement Process improvement Process improvement Prevail of equipment Prevail of equipment Prevail of equipment Prevail of equipment Incentive lines Improvement Improvement Improvement Improvement Change of energy vector Hot vater preparation by least pump Electric energy Ratio Emissions (Eo2/Jear Improvement/Eo2/Jear Change of energy vector High efficiency valable flow 20½ 17445.00 149.9570077 9.09 Change of energy vector High efficiency LPB burners for stam generation 40½ 23260.00 133.80834 12/147 Change of energy vector LPB burner in direct at vein 20½ 23260.00 612.9118339 13.33 Change of energy vector LPB burner in direct at vein 20½ 37280.00 207.9395806 132.84	Incentive lines	第二表				
Process improvement Process	Change of energy vector					
Incentive lines Actions Energy savings (2) Electric ener savings (2) Ratio (investment/savin) Emissions (Co2/gear Change of energy vector Hot water preparation by heat pump 60% 3605500.00 1615649183 187311 Change of energy vector Hot water preparation by heat pump 60% 3605500.00 1615649183 187311 Change of energy vector High efficiency, variable flow LPG burner 20% 17445.00 448.9570077 9.09 Change of energy vector High efficiency (20%) 103.810834 12147 103.810834 12147 Grange of energy vector LPG burner in directal vein process hot water 20% 23280.00 103.810834 12147 Grange of energy vector LPG burner in directal vein process hot water 60% 37280.00 207.985806 132.84	Industrial buildings					
Please select below the actions that you consider of interest to implement: Incentive lines Actions Energy savings (P Electric energy (investment/savin) Emissions (Co2/gear Change of energy vector Hot water preparation by least 600: 360500.00 1615649183 1879.11 Change of energy vector High efficiency, variable flow 200: 17445.00 448.9570077 9.03 Change of energy vector High efficiency is used on the saving of energy vector Electric energy vector 107.45.00 448.9570077 9.03 Change of energy vector LPG burner 400: 232600.00 193.810834 121.47 Change of energy vector LPG burner in direct air vein 200: 232680.00 612.8118339 13.33 Change of energy vector LPG burner in direct air vein 200: 372180.00 207.9385606 152.84	Process improvement					
Incentive lines Actions Energy savings () Electric ener savings Ratio (investment/savin) Emissions (Co2/gear Change of energy vector Hot water preparation by heat pump 60% 3605300.00 1615649183 1879.11 Change of energy vector High efficiency, variable flow LPG burner 20% 17445.00 443.9570077 9.09 Change of energy vector High efficiency LPG burners for steam generation 40% 23260.00 133.810834 121.47 Change of energy vector LPG burner in direct at vein process hor vector 20% 23280.00 612.8118339 13.33 Change of energy vector LPG burner in direct at vein process hor vector 50% 372180.00 207.9358606 132.84	Renewal of equipment					
Incentive lines Actions Energy savings () Electric ener savings Ratio (investment/savin) Emissions (Co2/gear Change of energy vector Hot water preparation by heat pump 60% 3605300.00 1615649183 1879.11 Change of energy vector High efficiency, variable flow LPG burner 20% 17445.00 443.9570077 9.09 Change of energy vector High efficiency LPG burners for steam generation 40% 23260.00 133.810834 121.47 Change of energy vector LPG burner in direct at vein process hor vector 20% 23280.00 612.8118339 13.33 Change of energy vector LPG burner in direct at vein process hor vector 50% 372180.00 207.9358606 132.84						
Incentive lines Actions savings (*) savings (*) savings (*) investment/savin (*) tCo2/gear (*) Change of energy vector Hot water preparation by heat pump 60% 3605300.00 1615649183 1873.11 1873.11 Change of energy vector High efficiency, variable flow LPG burner 20% 17445.00 449.9570077 9.09 121.47 Change of energy vector LPG burner in direct at vein for stream generation 40% 22860.00 153.81833 121.47 Change of energy vector LPG burner in direct at vein for stream generation 20% 22860.00 612.818833 13.33 Change of energy vector LPG burner in direct at vein process hor to buler with process hor to water 20% 32280.00 612.818833 13.33	\checkmark	Please select below the action	ns that you con	sider of interest to	implement:	
Incentive lines Actions savings (*) savings (*) savings (*) investment/savin (*) tCo2/gear (*) Change of energy vector Hot water preparation by heat pump 60% 3605300.00 1615649183 1873.11 1873.11 Change of energy vector High efficiency, variable flow LPG burner 20% 17445.00 449.9570077 9.09 121.47 Change of energy vector LPG burner in direct at vein for stream generation 40% 22860.00 153.81833 121.47 Change of energy vector LPG burner in direct at vein for stream generation 20% 22860.00 612.818833 13.33 Change of energy vector LPG burner in direct at vein process hor to buler with process hor to water 20% 32280.00 612.818833 13.33						
Change of energy vector pump BUX 3805300.00 161.564383 187.311 Change of energy vector High efficiency, valable flow LPG burnet 20% 17445.00 449.9570077 9.09 Change of energy vector Substitution of fuel oil for high efficiency LPG burnets 40% 232680.00 133.810834 121.47 Change of energy vector LPG burnet indext all vein 20% 23260.00 612.816839 13.33 Replacement of boiler with process hot water Petholer with process hot water 60% 372160.00 207.9865606 192.84	Incentive lines	🐺 Actions 👻				
Change of energy vector LPG burner 20% 1/445.00 44335/100/7 30.9 Change of energy vector Substitution of livel oil for for steam generation Substitution of livel oil for for steam generation 222800.00 123.810834 12/147 Change of energy vector LPG burner index at velo Pepticerement of boller with process hold water 20% 23280.00 612.816839 13.33	Change of energy vector		60%	3605300.00	161.5649183	1879.11
Change of energy vector high efficiency LPG burners for steam generation 40% 232600.00 133.810834 121.47 Change of energy vector LPG burner inflect at velo heat pump for DFIV and process hort water 20% 23260.00 612.816839 13.33 Change of energy vector Heat pump for DFIV and process hort water 60% 372180.00 207.9965606 152.84	Change of energy vector		20%	17445.00	449.9570077	9.09
Change of energy vector LPG burner in direct air vein 20% 23260.00 612.816833 13.33 Replacement of bolie with heat pump for DHV and process hor water 60% 372160.00 207.9965606 192.84	Change of energy vector	high efficiency LPG burners	40%	232600.00	139.810834	121.47
Change of energy vector heat pump for DHV and 60% 372160.00 207.3985806 192.84	Change of energy vector	LPG burner in direct air vein	20%	23260.00	612.8116939	13.33
	Change of energy vector	heat pump for DHV and process hot water	60%	372160.00	207.9965606	192.84
			Energy saving (I	k∀h/Year)		
Energy saving (k¥h/Year)			CO2 emissions	saved per year (kg	CO2 eq)	

Figure 10. Visualization of the tool implementing the calculation of the Industry actions



2.1.3.3. Section 3: Municipal Buildings and Equipment

The actions proposed in the section on Municipal Equipment and Facilities are also maintained in accordance with report D3.1, and are shown below:

Co-funded by the European Union	SECAPs MO	NITORING TOOL	UNIVERSIDAD POLITECNICA DE VALENCIA		
	MUNICIPAL BUI	LDINGS AND PUBLIC FACILI	TIES		
DESCRIPTION: This section is	ncludes all actions related to municipal buildings	and equipment under the responsibility of the city council.			
Improving the insulation of municipal buildings Window improvements (replacement of glass) and façade insulation.					
Improvement of municipal	lighting	Replacement of luminaires with more efficient luminaires			
Heating, ventilation and air-conditioning systems		Improvement of heating, cooling and DHW systems.			
Introduction of renewable energies and self-consumption		Possibility of integrating renewable energies such as: solar thermal, photovoltaic and biogas, as well as introducing self-consumption at municipal level.			
Municipal vehicle fleet		Current municipal vehicles: retired versus purchased v	vith new technologies (hybrid and electric).		

Figure 11. Actions implemented in the Municipal Buildings and Equipment section of the toolkit

No significant changes have been made to the proposed measures. It should simply be noted that some calculations have been simplified (such as that of the batteries) due to the need to enter a lot of data. For more specific calculations, more in-depth studies can be carried out. The following figures show the different actions in relation to municipal equipment and buildings.

1	1	mproving the insulation of	of municipal buildings	LOCATION BALEARES	
WINDOWS					
	Select from the list			Enter manual	Default value
[1] Current windows	Frame improvement		[1] Transmittance (₩łm2K)	Entermanual	3.2
[2] New windows	Double glazing b	Jefault value	[2] Transmittance (¥/m2K)		1.8
Surface to be replaced (m		0.012			
	nergy saving (k∀h/Year) sions saved per year (kgCO2 eq)		3387.686		
INSULATION					
[1] Current Isolation	Select from the list Expanded Polystyrene		[1] Material conductivity (¥/m	Select from the list	Default value 5.7
Is the insulation replaced or added to the existing insulation?	Replacement YES		[1] Insulation thickness (m)	Select from the list	0.04
[2] Insulation New	Gypsum panel		[2] Material conductivity (¥/m		0.17
Surface to be replaced (m Ceilings (m2) Valls (m2) Usable surface		Gefault value 125	[2] Insulation thickness (m)		0.06
Energy saving (k	⊯h/Year)		2210.3825		
CO2 emissions s	aved per year (kgCO2 eq)		994.672		

Figure 12. Visualization of the tool implementing the calculation of the improvement of insulation in municipal buildings



I	lm.	provement of municip	al light	ing			
BUILDINGS							
	Select from the list				Enter manual		Default value
[1] Current Bulbs	Incandescentes]		[1] Max. Power (V)			40
		-					
[2] New Bulbs	LEDs]		[2] Max. Power			9
	Enter manual	-			Enter manual	Elefault value	
Number of luminaires to be replaced	20			Hours of use (h) [SUMMER].		7.5	
						-	
STREETS							
	Select from the list				Enter manual		Default value
[1] Current Bulbs	Tubos fluorescentes]		[1] Maz. Potencia (¥)			63
[2] New Bulbs	Sodio AP (HPS)	1		[2] Max. Potencia (W)			50
	Enter manual	-			Enter manual	Default value	
be replaced	1		*	Hours of use (h) [SUMMER].	0	10	
				Hours of use (h) [VINTER].	0	14	
Energy saving (I	k ∀h/ Year)		-	177.06			
CO2 emissions	saved per year (kgCO2 eq)			79.677 🏠			

Figure 13. Visualization of the tool implementing the calculation of the improvement of municipal lighting

Heating, ventilation and air	conditioning systems
Select the option that best suits your current system : Heating, cooling and DHW in independent systems Click on the number that corresponds to the chosen option:	34
Energy Consumption kVh/Year) CO2 Emissions (gCO2 eq)	3675.28 1233.425
N	EW SYSTEM
Please select the type of system to be used Heating and DHW in one system, independent cooling Click on the number that corresponds to the chosen option:	
Energy Consumption (k¥h/Year)	
CO2 Emissions (gCO2 eq) Daily Energy Savings (kVh/Year)	1670.77 C
CO2 Emissions Saved Annual (gCO2 eq)	633.856

Figure 14. Visualization of the tool implementing the calculation of the improvement of heating, ventilation and air conditioning systems



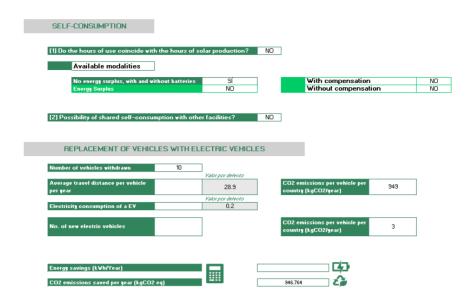
*	Introduction o	f renewable energies a	and self-consump	tion		
DATA						
[1] Type of building Cole	gio	No. of workers	25	Unit consumpti	on of DH¥ (I/day)	525
[2] Usable surface 10	0] Default value				
[3] Hours of use		10				
[4] Annual electrical demand of the building (K¥h)		10950				
SOLAR THERMAL	Solar	Thermal Energy?	SÍ			
Daily consumption (m3/s)		0.0000058		Useful surface (m2)	5	7
DHV demand (KVh/gear)		9580.9				
Storage tank (L)	500					
Type of solar collector	Flat Collector	Performance(%)	Default va 0.68	lve Collector area	Default value 2	
Generated power (kW)/Collector	1.13	Total Power General	ted (k¥)	4.53		
Total Energy Generated	7309.26]				
Energy savings (k¥h/Year)			7309.26			
CO2 emissions saved per year (kgCl	J2 eq)		3289.166	22		

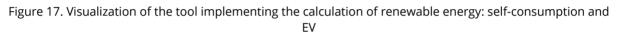
Figure 15. Visualization of the tool implementing the calculation of renewable energy: solar thermal

PHOTOVOLTAIC	Solar	Energy System?	Sí Batteries for sto Surplus cor	
Building energy consumption		10950		
Types of solar collector	Monocrystalline	Performance (%)	Default Value 0.23 Collector s	Default Value ize (₩) 100 200
Power generated (kWh)	6990.306625		Number of	collectors 1
Battery capacity (Ah)		0		
Stored Energy (k¥h)				
Energy savings (kVh/Year) CO2 emissions saved per year (kgCl	J2 eq)		3959.69 [1781.862 2	
BIOMASS	Anaerobic			
Kg of waste per day	18000			Types of organic waste Kg
Percentage of organic waste (%)		50%		imal origin 18000 nt origin
			Hu	man origin
Organic mass (kg per day)	9000			ro-industrial estry
Volume of Methane generated (CH4)	2323		Aq	uatic Crops
Reactor recovery efficiency (%)		60%		
Volume of methane available	1394			
Energy generated (k¥h/day)	588			
		_		
Energy savings (k\#h/Year)			214673.76	<u> </u>
CO2 emissions saved per year (kgC(02 eq)		96603.193 🕹	2

Figure 16. Visualization of the tool implementing the calculation of renewable energy: photovoltaic and biomass







2.1.3.4. Section 4: Transport

Finally, the actions proposed for the Transport section have also been maintained following the indications of report D3.1.

Contraded by the European Union	SECAPs MO	NITORING TOOL	UNIVERSIDAD POLITECNICA DE VALENCIA	Instituto Ingeniería Energética	
* ***	т	RANSPORT			
DESCRIPTION: This section includes	information and actions rel	ated to the improvement of transport at mu	nicipal level.		
Cycling Routes	cling Routes Emission savings per km of cycling compared to conventional vehicles.				
Network of EV recharching points		Emission savings per installed rechargi	ng point		
Promoting public transport		Municipal transport-related awareness	-raising measures		

Figure 18. Actions implemented in the Transport section of the toolkit

The actions have been properly implemented in the tool, as shown in the following figures:

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50	Cycling Route	LOCATION CANARIAS					
	Inhabita	nts					
[1] Number of inhabitants in the municipality	50252 km						
[2] Distance of built-up cycleway	0.5]					
[3] gCO2 emissions generated	4954.8472]					
[4] gCO2 emissions saved	11692.376]					
			0.000				
Energy saving (kW	Energy saving (kWh/Year)						
CO2 emissions sav	ed per year (kgCO2 eq)		6737.529	2à			

Figure 19. Visualization of the tool that implements cycleway savings in the Transport section

iæ,	Network of EV rech	arging points	
[1] Number of chargers installed	8]	
[2] Charger power (kW)		20	Standard charger
[3] Power supplied by charger (kWh)	29200		
[4] Electric vehicle consumption (passenger	0.200]	
[5] Cars supplied		40	
[6] allowable km		1460	Default Value
Energy saving (kW	/h/Year)		0.000
CO2 emissions say	ved per year (kgCO2 eq)		2931680.000

Figure 20. Visualization of the tool that implements EV recharging points savings in the Transport section

Accrease in the frequency of PT 10% X 0.18 assage educing fees for Youth and 5% X 0.09 ensioners 97% X 1.79 olls (depending on rush hour or of) ongestion charging (reducing the 20% 0.00		Please select the measures applied in the promotion of public transport:										
Increase in the frequency of PT 10% X 0.18 assage 5% X 0.09 educing fees for Youth and ensioners 5% X 0.09 cozone (ZBE) 97% X 1.79 obles (depending on rush hour or opestion charging (reducing the cozone (20%) 30% 0.00		Share CO2 savings	Apply	municipality								
assage 11990 X 0.18 educing fees for Youth and ensioners 5% X 0.09 cozone (ZBE) 97% X 1.79 olls (depending on rush hour or ot) 30% 0.00 ongestion charging (reducing the 20% 20% 0.00	educed Speed Zones	25%	х	0.46								
ensioners X U.09 cozone (ZBE) 97% X 1.79 olls (depending on rush hour or 30% 0.00 ot) 0.00	ncrease in the frequency of PT passage	10%	х	0.18								
orls (depending on rush hour or ot) ongestion charging (reducing the 20% 0.00	Reducing fees for Youth and Pensioners	5%	x	0.09								
ot) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	Ecozone (ZBE)	97%	х	1.79								
		30%		0.00								
	ongestion charging (reducing the umber of cars entering the city	20%		0.00								
TOTAL 2.53			TOTAL	2.53								

Figure 21. Visualization of the tool that implements Public Transport measures



2.1.4. Multi-criteria Decision-Making

Multi-criteria evaluation of alternatives is considered to be the application of a method that allows the integration of quantitative and qualitative aspects of evaluation to obtain feasible solutions to be applied in SECAPs from a broader approach. Not only are the technical or economic parameters of the implementation of sustainability-related measures, such as photovoltaic solar energy in isolated communities, considered, but also the environmental, social and political variables involved in the final decision. As proposed in report D3.1, the Analytical Hierarchical Process (AHP) method has been implemented.

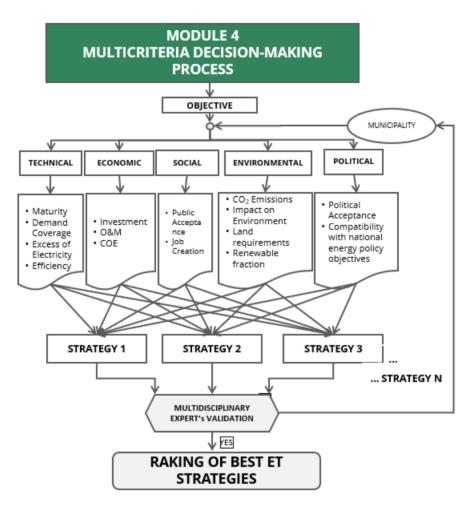


Figure 22. Outline of the AHP method with the defined criteria and sub-criteria

In order to apply the AHP method, the user is requested to enter his/her preferences, in terms of municipal interest, in a GENERA tool like the following figure:

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Co-funded by the European Unit	G		SECAPS MONITORING TOOL	
			MultiCriteria Decision Making	
DESCR	IPTION: The user	must prioritise b	etween the different criteria and alternatives.	
	GOAL	Create	a SECAP considering the results of the measures of the Inference module and the casuistry of the municipality.	
	CRITERIA			
N*	Criteria		rnatives	
1	Technical		bal Buildings	
2	Economic Social	Industry		
4	Ecological Imp	Transpo act Awaren		
5	Political	act Awaren	(62)	
6	. onto di			
What Techr		ider most ir	mportant? Please enter in the box of the criterion you consider most important the weighting from 1 to 10. 10 - most important 1- least importan Economic	
Techn			Social	
Techn				
Techn			Ecological Impact Political	
Econo			Social	
Econo			Ecological Impact	
Econo			Political	
Social				
Social			Ecological Impact Political	
			Political	
E C010	gical Impa <u>ct</u>			

Figure 23. GENERA tool for the multi-criteria decision making method

This information is transferred to another tool where the AHP method will be applied according to the user's preferences. This is the **Super Decisions**¹ software as a decision support method that implements the AHP. The objective would be to achieve a planning of measures according to the municipal casuistry.



Figure 24. Visualization of the Super Decisions Software to implement the AHP method

The indicators that have been chosen to evaluate the different alternatives are shown in the following table. In addition, it is also indicated to which criteria (second level) each one of them applies.

Indicator	Criteria to which it applies
Maturity	Technical
Municipal RE Share (%)	Technical, Ecological impact

¹ https://www.superdecisions.com/



Indicator	Criteria to which it applies
Appual Energy Savings (MW/b)	Technical, Economic, Ecological
Annual Energy Savings (MWh)	impact
Annual RE Production (MWh)	Technical
Implementation Rate	Technical
Investment	Economic
Annual Profitability (kWh/€)	Economic
Available Funding and Grants	Economic
Public Acceptance	Social, Political
Job Creation	Economic, Social, Political
CO ₂ Emissions Reduction (tCO ₂)	Ecological impact, Political
Biodiversity Impact	Ecological impact
Land Change of Use	Social, Ecological impact, Political
Political Acceptance	Political
Compatibility with national Policies	Political
Compatibility with regional Policies	Political
Compatibility with EU Policies	Political

Table 1. Indicators included in the AHP method

Thus, each of the actions included in the municipal AP will be evaluated according to the established criteria and indicators. Each policy maker should evaluate according to their policy which criteria have more weight in their method of governance, and the value of each of the measures in relation to the established indicators.

Each indicator will first be compared with respect to the criteria given, as shown in the following figure:

	Comparisons wrt "B1 Technical" node in "4 Indicators" cluster B1.2 Municipal RE Share (%) is moderately more important than B1.1 Maturity																			
1.	B1.1 Maturity	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
2.	B1.1 Maturity	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
3.	B1.1 Maturity	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
4.	B1.1 Maturity	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
5.	B1.1 Maturity	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
6.	B1.2 Municipal ~	>=9.5	9	8	7	<mark>6</mark>	5	4	3	2	1	2	3	4	5	6	7	8	9	>
7.	B1.2 Municipal ~	>=9.5	9	8	7	<mark>6</mark>	5	4	3	2	1	2	3	4	5	6	7	8	9	>
8.	B1.2 Municipal ~	>=9.5	9	8	7	<mark>6</mark>	5	4	3	2	1	2	3	4	5	6	7	8	9	>
9.	B1.2 Municipal ~	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
10.	B1.3 Annual Ene~	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
11.	B1.3 Annual Ene~	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
12.	B1.3 Annual Ene~	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
13.	B1.4 Municipal ~	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
14.	B1.4 Municipal ~	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>
15.	B1.5 Annual R E~	>=9.5	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	>

Figure 25. Comparison of indicators according to the given criteria. Screenshot of the *Super Decisions* software



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The same procedure will then be carried out with an alternative face for each indicator. Finally, a report will be obtained evaluating each alternative with the municipal criteria and will result in a ranking of measures specific to that municipality.

Graphic	Alternatives	Total	Normal	Ideal	Ranking
	CA1.1 Improving the insulation of municipal buildings	0.0101	0.0303	0.0763	8
	CA1.2 Improvement of municipal lighting	0.0160	0.0484	0.1218	7
	CA1.3 Heating, ventilation and air-conditioning systems	0.0316	0.0953	0.2400	4
	CA1.4 Introduction of renewable energies and self-consumption	0.1317	0.3969	1.0000	1
	CA1.5 Municipal Transport Reposition	0.0060	0.0181	0.0456	9
	CA2.1 Industrial Process improvement	0.0029	0.0087	0.0219	13
	CA2.2 Renewal of industrial equipment	0.0027	0.0081	0.0204	14
	CA2.3 Improvement of Industrial buildings	0.0059	0.0178	0.0449	10
	CA2.4 Change of energy vector	0.0049	0.0149	0.0375	11
	CA3.1 Cycling Routes	0.0320	0.0966	0.2433	3
	CA3.2 Network of EV recharging points	0.0185	0.0559	0.1408	6
	CA3.3 Promoting public transport	0.0226	0.0682	0.1718	5
	CA4.1 Ecomovil	0.0045	0.0135	0.0341	12
	CA4.2 Information stands	0.0422	0.1273	0.3208	2

Figure 26. Final evaluation of alternatives. Screenshot of the *Super Decisions* software.



3. Pilots Results

In this section the ET tools are validated in 6 municipalities of GENERA's tourist islands: **2** in Spain, **1** in Italy and **3** in Greece. This is done as a pilot to get feedback on the use of the tools, and to be able to improve them in the future according to the comments. As mentioned above, first a national analysis is carried out, and then the focus will be on the municipalities of interest.

In order to understand the different regions, a first analysis was carried out in Deliverable *"D4.1 Road-mapping needs, typology, Island-specific recipes"*. It consisted of a first characterization of the island regions located in Spain (Balearic and Canary Islands), France (Corsica), Italy (Sicily and Sardinia) and Greece (North Aegean and South Aegean).

This section is then divided according to the different countries in which the pilot municipalities are located: Spain, Italy and Greece. For each country, the study of the national energy context will be carried out using the corresponding tool, and then the specific modules for each municipality will be used.

3.1. Spain

Spain is a country that has a uniform overall production with several energy sources, with the greatest variation in the use of natural gas and the expected variation in solar energy production. Spain in particular is characterized mainly by low per capita electricity consumption, as well as lower mineral depletion. Consequently, based on these low levels of per capita electricity consumption, one of the clear objectives for these countries is to continue modifying the electricity matrix towards greater generation from renewable sources. Spain, Italy and Spain have very similar electricity generation from renewable sources, around 45% of total electricity [1].

In relation to the Spanish islands and archipelagos of the Balearic and Canary Islands, they are said to have a high population density, but are also characterized by a fair employment rate, and are highly dependent on tourism, especially the Balearic Islands.

3.1.1. Study of the Spanish National Context

At the national level, this section studies the energy context in Spain. The reference data are taken from the year 2023, which is the year for which complete information is available. In general terms, the Spanish energy mix in relation to energy supply is mainly divided into oil (42.9%), followed by natural gas (22.5%), nuclear energy (13.2%) and continued by geothermal, solar and wind energy, biofuels and waste and hydroelectric energy. CO₂ emissions in Spain have been reduced by 22% with respect to 2000 data, and this places Spain as the producer of 0.64% of global emissions.

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Energy mix Total energy supply, S	ipain, 2023				Emissions Energy-related CO2 emissions, S	Spain, 2022
Total energy supply	Production	Electricity	Consumption		217 Mt CO2	
Coal Oil 2.4% 42.9%		Natural g 22.5%	us Nuclear 13.2%	Biofuels and waste 7.4%	0.64% of global emissions	122% change since 2000

Figure 27. Summary of Spain's energy mix and emissions. Source: <u>https://www.iea.org/countries/spain</u>

In this case, Module 1 of the GENERA tools is used, which calculates the energy context of the selected country. The data entered in the tool take 2022 as the reference year (since 2023 is incomplete for some sectors) and comes from the International Energy Agency [1].

First, an overview of the contribution of each energy source in the main sectors of the Spanish economy is obtained: transport, industry, residential, services and others (agriculture, fishing, etc.). In addition, the contribution to electricity generation is also shown.

Oil is the main source in the transportation sector and in other sectors such as agriculture, fishing, etc. On the other hand, natural gas is more involved in the industry, residential and service sectors. In addition, in electricity production, natural gas and renewables are the main producers.

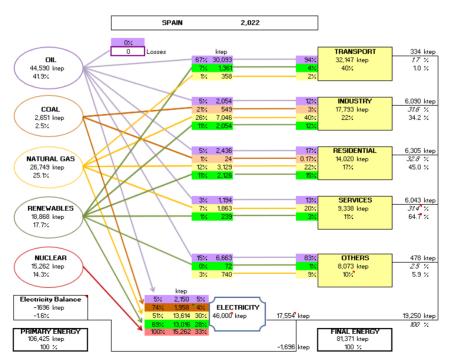


Figure 28. Energy balance of the different energy sources and sectors in Spain



Subsequently, the tool calculates the progression of different indicators, such as primary energy demand, electricity generation and emissions up to 2030, following current trends.

Figure 29 shows the evolution of primary energy demand in the current Spanish system. According to the data shown in Figure 28, the greatest demand is for oil and, although it is possible that policies to reduce the use of oil will be implemented, according to the current situation it will continue to grow progressively. Likewise, the trend of renewable energies is also growing and, with the application of measures to promote their use, they could even equal the use of natural gas. Finally, nuclear energy and coal remain constant, with coal being the least demanded energy.

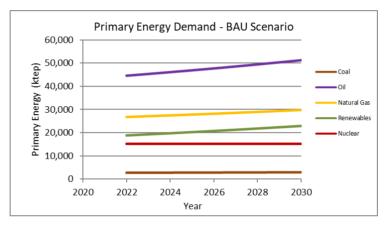


Figure 29. BAU Spain Scenario: Primary Energy Demand

In relation to the contribution of each source to electricity generation, nuclear energy in Spain stands out for its production and stability, which is characteristic of this energy source. Also noteworthy is the growing generation by renewable energies, which will continue to grow and, if measures are implemented, could even increase. In addition, the growing use of natural gas also stands out. The latter could decrease in the future due to the recent conflict with Russia, as the demand for gas in Europe has decreased. Finally, oil and coal maintain a similar and stable value and are the last sources in terms of contribution to electricity generation.



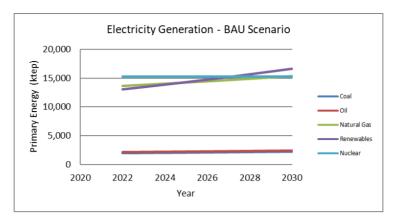


Figure 30. BAU Spain Scenario: Electricity Generation

A further outcome of this tool is the contribution of each sector, for example, in terms of CO₂ emissions generation. In Spain, the main CO₂ generating sector is transportation, so implementing measures to reduce it is of paramount importance. This is followed by the electricity sector, which could be reduced by encouraging the use of renewable energy or less CO₂-producing sources such as natural gas. Minor emissions are found in the agriculture and fishing, industrial, residential and services sectors.

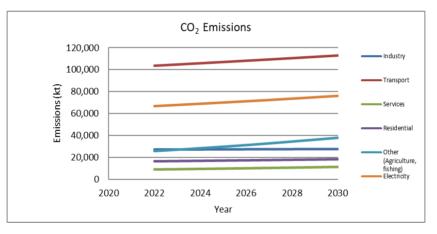


Figure 31. BAU Spain Scenario: CO₂ Emissions

In summary, Spain's energy context is characterized by the use of oil mainly for the transport sector, which in turn generates most of the country's emissions. On the other hand, there is a growing trend towards the use of renewable energy, mainly for electricity production, but also for residential use. Natural gas also shows a growing trend and greater involvement in the industrial, residential and service sectors. The use of nuclear energy provides a stable energy base that, for now, is maintained over the years. Finally, the use of coal is very low. In terms of emissions, the most damaging sector is transport, followed by electricity generation. All this should be considered when creating action plans, as more sustainable future scenarios can be achieved by implementing policies to reduce emissions and support renewable energies



3.1.2. Pilot 1 in Ibiza (Balearic Islands): Sant Antoni

3.1.2.1. Features of Sant Antoni de Portmany

Sant Antoni de Portmany is located in the northwest of the island of Ibiza. The municipality has an area of 12,662 hectares and a population of 27,431 inhabitants [2]. In 2021 the city council of Sant Antoni de Portmany signed the new Covenant of Mayors for Climate and Sustainable Energy, which implied that all the commitments established in the 'document of official commitments' would be assumed in this plenary document.

The climate in Sant Antoni de Portmany is a local steppe. It is characterized by little rainfall during the year. The average temperature in Sant Antoni de Portmany is 18,5 °C. The consequences of climate change are multiple and the impact on the water cycle has important effects on the development of an area's activities. The influence of human activity in this aspect is the cause of current water-related risks and vulnerabilities, from long periods of drought to the presence of a significant risk of flooding. The municipality of Sant Antoni de Portmany, after the signing of the Covenant must consider "the adaptation of the structures including the allocation of appropriate human and economic resources" as a formal commitment. The creation and implementation of sustainable energy policies is a process that requires a lot of time and effort and has to be systematically regulated and supervised between the different areas of administration: environment, planning, intervention, social affairs, municipal services, mobility, economic area, participation etc.

Section	Objective
Renewable energy	It has set the promotion of renewable energies so that they represent at least 32% of the energy consumption of the municipality in the year 2030, in order to make its commitment to the Covenant of Mayors for Energy and Climate a reality.
Energy efficiency	Increase the city's energy efficiency by 32.5% by the year 2030, with respect to 2005 energy consumption, in order to fulfil its commitment
CO ₂ emissions	The global emissions reduction target for the year 2030 in the municipality of Sant Antoni de Portmany of 55% of 2005 emissions represents a reduction of 63,838.23 tons of CO ₂ .

Among the main objectives set at the municipal level are:

Table 2. Municipal objectives of Sant Antoni de Portmany



3.1.2.2. Summary of actions of Sant Antoni de Portmany

After a detailed study of the actions included in Sant Antoni De Portmany at municipal level and, specifically, in the Covenant of Mayors for Climate and Energy, for the creation and updating of the Action Plan [3], the measures are introduced in the GENERA tool for the evaluation of alternatives. The actions have been considered according to the different sections detailed in the inference module.

G Municipal Buildings And Public Facilities

• Indoor lighting renovation

The city council will commit to a policy of purchasing more energy-efficient lighting fixtures. It includes 13 buildings and a cost per building of \in 8,000. It is considered that 12% of the usable area of public buildings should be destined to natural ventilation and lighting. This implies that in Sant Antoni de Portmany, considering 13 buildings in which to intervene (5 schools, town hall, municipal swimming pool, sports pavilion, bus station and other large buildings), with an average of 600 square meters of usable area, it is intended to refurbish 936 square meters.

1		Improving the ins	ulation of municipal buildings	LOCATION BALEARES]
WINDOWS					
	Select from the list			Enter manual	Default valu
[1] Current windows	Frame improvement		[1] Transmittance (W/m2K)		3.2
[2] New windows	Double glazing b		[2] Transmittance (W/m2K)		1.8
	Enter manual	Default value			
Surface to be replaced (m2)	936	0.012			
	inergy saving (kWh/Year) ssions saved per year (kgCO2 eq.		1056958.157 4 75631.171		

Figure 32. Improvement of the windows of Sant Antoni de Portmany

Substitution Of Lights For More Efficient Ones

On the other hand, another action is the replacement of lighting fixtures in buildings and streets with more efficient ones, such as LEDs.



	Ĵ,	mprovement of mur	nicipal lighting			
BUILDINGS						
[1] Current Bulbs	Select from the list CFL y Fluorescentes	_	[1] Max. Power (¥)	Enter manual		Default value 12
	Ci E gridorescentes		[1] Inida. 1 Ower (w)			16
[2] New Bulbs	LEDs		[2] Max. Power			9
Number of luminaires t	Enter manual			Enter manual	Elefault value	
be replaced	20		Hours of use (h) [SUMMER].		7.5	
STREETS						
STREETS						
	Select from the list	_		Enter manual		Default value
[1] Current Bulbs	Metal Halogen		[1] Maz. Potencia (¥)			42
[2] New Bulbs	LEDs		[2] Max. Potencia (W)			33
[-]	Enter manual			Enter manual	Diefault value	
be replaced	50		Hours of use (h) [SUMMER].	0	10	
			Hours of use (h) [VINTER].	0	14	
Energy saving	(kWb/Year)		1955.7			
Licity suring	(Kamita)					
CO2 emission	s saved per year (kgCO2 eq)		880.065 🐔 🎽			

Figure 33. Change of lighting fixtures in public buildings and streets in Sant Antoni de Portmany

• Installation of aerothermal energy in municipal facilities

In this case, a change is made in the air conditioning system of several public buildings. These have a standard oil boiler for heating and domestic hot water, whose energy consumption is as follows:

Current system selected				
2 Heating and DHW in one system, indep	endent cooling			
Please enter your heating demand				
- HEATING				
Enter manual [1] Current heating demand (k∀hłyear		Default Value 12000		
[2] Useful surface to heat (m2)	1200			
[E] OSCIAL SALLACE OF ICAL (INE)	1200			
Select the heating emitter system				
[3] System	Boiler		3.1]Type of boiler	Estándar
		•		
		E	[3.2] Fuel	Gasol Default Value
		E.	3.3] Litres of fuel (L) (GN (m3)	1440
				•
			3.4] Energy label	В
			3.5] Performance	90%
		L	5.5] Ferformance	307.
ACS				
		Default Value		
Domestic Hot Vater Demand (DHV) kVh/year		Default Value 1898.243	_	
Domestic Hot Vater Demand (DHV) kVh/gear If the value is unknown:				
	Offices	1898.243 N* workers	50	
If the value is unknown:	Offices	1898.243 N* workers Default Value 100	50	
If the value is unknown: Type of facility	Offices	1898.243 Nº workers Diefault Value	50	
If the value is unknown: Type of facility Unit DHV consumption (Mday)	Offices	1898.243 N+ workers Derault Yalve 100 Derault Yalve	50	
If the value is unknown: Type of facility Unit DHV consumption (Mday)	Offices	1898.243 N+ workers Derault Yalve 100 Derault Yalve	50 [4.1] Type of boiler	Estándar
If the value is unknown: Type of facility Unit DHV consumption (Mday)	Offices	1898.243 N+ workers Derault Yalve 100 Derault Yalve		Estándar Gazoli
If the value is unknown: Type of facility Unit DHV consumption (Mday)	Offices	1898.243 N+ workers Derault Yalve 100 Derault Yalve	[4.1] Type of boiler [4.2] Fuel	
If the value is unknown: Type of facility Unit DHV consumption (I/day)	Offices	1898.243 N+ workers Derault Yalve 100 Derault Yalve	[4:]] Type of boiler [4:2] Fuel [4:3] Litres of fuel (L)	Gasoil Default Value 188.081
If the value is unknown: Type of facility Unit DHV consumption (I/day)	Offices	1898.243 N+ workers Derault Yalve 100 Derault Yalve	[4:1] Type of boller [4:2] Fuel [4:3] Litres of fuel [L] [1:3] Kg of fuel (kg) - Pelleter/Bioma	Gasoil Zielauk Pabe 198.081 sa 0.000
If the value is unknown: Type of facility Unit DHV consumption (Mday)	Offices	1898.243 N+ workers Derault Yalve 100 Derault Yalve	[4:1] Type of boiler [4:2] Fuel [4:3] Litres of fuel (L) [1:3] Kg of fuel (kg) = Pellets/Bitoma [4:4] Energy Tabel	Gasoll Civisuit False 180.081 Sa 0.000 B
If the value is unknown: Type of facility Unit DHV consumption (I/day)	Offices	1898.243 N+ workers Derault Yalve 100 Derault Yalve	[4:1] Type of boller [4:2] Fuel [4:3] Litres of fuel [L] [1:3] Kg of fuel (kg) - Pelleter/Bioma	Gasoil Zielauk Pabe 198.081 sa 0.000
If the value is unknown: Type of facility Unit DHV consumption (Mday)	Offices	1898.243 N+ workers Derault Yalve 100 Derault Yalve	[4:1] Type of boiler [4:2] Fuel [4:3] Litres of fuel (L) [1:3] Kg of fuel (kg) = Pellets/Bitoma [4:4] Energy Tabel	Gasoll Civiout Value 196.091 5-3 B
If the value is unknown: Type of facility Unit DHV consumption (I/day)	Offices	1898.243 N+ workers Derault Yalve 100 Derault Yalve	[4:1] Type of boiler [4:2] Fuel [4:3] Litres of fuel (L) [1:3] Kg of fuel (kg) = Pellets/Bitoma [4:4] Energy Tabel	Gasoll Civiout Value 196.091 5-3 B

Figure 34. Calculation of the previous heating and DHW system in Sant Antoni de Portmany

The cooling system uses air conditioning fan coils, as shown in the figure below, with their respective energy consumption and emissions:

COOLING	is there a cooling system? Yes Enter manual I (k¥h/sear)	Default Value 18000	20	
[2] Useful surface to cool	(m2) 1200			
Select the cooling emitter system				
			[4] Fan No	
[3.1] Energy label	В	Default Value A	[4.1] Type of fan Star	nding
[3.2] Type of equipment	Air Conditioning		[4.2] Energy consumption per hour	Default Value 0.5
[3.3] Type of equipment	Fan Coils		[4.3] Hours of use per year	<i>Default Value</i> 0 hlyea
[3.4] SEER		8.5	[4.4] Number of fans	1
[3.5] Coolant used	Other			
[3.6] Cooling Consumption	n (k¥h/Year) 4491.58		[4.5] Total energy consumption of fans	0 kWh/year
			4491.578291	
CO2 Emissions (g	(CO2 eq)		2021.210231	

Figure 35. Calculation of the pre-cooling system in Sant Antoni de Portmany

The new system proposed is the use of an aerothermal system, both for heating and cooling and for domestic hot water. The energy consumption and emissions can be seen in the following figure

NEW SYSTEM							
Please select the type of system to be used Heating, DHW and cooling in one system							
HEATING		[3.1]Type of boiler	Estándar				
Select the heating emitter system		[3.2] Fuel	Electricity Default Value				
[3] System Heat Pump Silect	 Default Value		Leroun your				
[4] Energy label A++ Select							
[5] Type of equipment Aerothermal energy. Centralized equipment [5.1] Type of equipment Fan Colls]	[3.4] Energy label [3.5] Performance	#N/D				
[5.1] Type of equipment Fan Coils [6] SCOP	5.		#NetO				
		-					
Heating Demand (k¥h/Year) CO2 Emissions (gCO2 eq)		2941.18					
ACS							
Type of DHV heater Heater							
HEATER							
[2.1] Energy label A							
[2.1] Energy rader Select [2.2] Type of equipment Aerothermal energy. Centralized equi	oment						
[2.4] SCOP	4						
		l					
Heating Demand (k¥h/Year)		3871.245884					
CO2 Emissions (gCO2 eq)		1529.317621					
State Cooling							
Select the cooling emitter system							
		[4] ¥entilador	No				
[3.1] Energy label A++	Default Value A	[4.1] Type of fan	Standing				
[3.2] Type of equipment Aerothermal energy. Centralized equipment		[4.2] Energy consumption pe	r hour 0,5				
[3.3] Type of equipment Fan Coils		[4.3] Hours of use per gear	900 h/year				
[3.4] SEER	8.5	[4.4] Number of fans	0				
[3.6] Cooling Demand (kVh/Year) 336.87		[4.5] Total energy consumpt	ion of fans 0 kWh/year				
Cooling Demand (k¥h/Year)		336.87					
CO2 Emissions (gCO2 eq)		151.5307673					

Figure 36. Calculation of the new air-conditioning system for public buildings in Sant Antoni de Portmany



In summary, the savings in terms of annual energy and CO₂ emissions are as follows:

	Heating, ventilation a	and air conditioning systen	ns]
Select the option that best suits y 2 Heating and DHW in on	our current system : e system, independent cooling			
Click on the number that corresp option:	onds to the chosen	2 3	4	
Energy Con	sumption k¥hłYear)		20101.00	
CO2 Emissi	ons (gCO2 eq)		9045.452	
		NEW SYSTE	Μ	
Please select the type of system				
4 H Click on the number that correspond option:	eating, DHW and cooling in one system is to the ohosen	23	4	
	sumption (k∀h/Year) ons (gCO2 eq)		3871.25	
Daily Energy Savings (k∀hłYe CO2 Emissions Saved Annua		16229.		

Figure 37. Energy savings and CO₂ emissions in the air conditioning of Sant Antoni de Portmany

• Photovoltaic solar energy installations

One of the other actions to be implemented was the introduction of renewable energy in public buildings. In this case, the option of photovoltaic solar energy was proposed, and monocrystalline panels were proposed. As the current energy consumption is not available, the estimate given by the tool is used. In addition, the use of batteries is not considered initially.

	* Introducti	on of renewable energies a	nd self-consumpti	ion	
DATA					
	Select from the list				
[1] Type of building	Public Utility Buildings	No. of workers	25	Unit consumption of DHV (I/day)	50
[2] Usable surface	1200				
		Default value			
[3] Hours of use		8			
[4] Annual electrical demand of the building (k∀h)		70080			

Figure 38. Necessary data for the introduction of renewable energy in Sant Antoni de Portmany



FOVOLTAIC	Solar Energy	y 5ystem?	Batteries for storage? N Surplus compensation	JO
Building energy consumption		70080		
			Default Value	Default Value
Types of solar collector	Monocrystalline Perfo	rmance (%)	0.23 Collector size (¥)	200
Power generated (k∀h)	13980.61325		Number of collectors	1
Battery capacity (Ah)		0		
Stored Energy (k∀h)				
Energy savings (k¥h/Year)			56099.39	

Figure 39. Use of renewable energy, solar panels, in Sant Antoni de Portmany

Replacement of municipal vehicles with more efficient ones •

It is proposed that the fleet of municipal vehicles be progressively replaced by lowemission and more efficient vehicles at the end of their useful life, such as electric vehicles or vehicles that use renewable sources. The acquisition of these vehicles by the municipality promotes their purchase by the population, especially if this good practice is properly disseminated. The number of vehicles to be replaced is 20.

GENERA's tool calculates the CO₂ emissions avoided with the new vehicles. If the emissions value for each vehicle is not known, the tool provides default values.

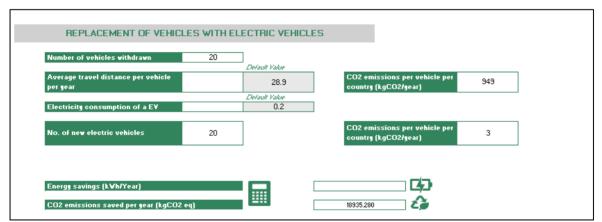


Figure 40. Replacement of conventional vehicles by electric vehicles in Sant Antoni de Portmany

G Industry

In this case, the municipality of Sant Antoni is committed to measures aimed at the residential and service sector, more related to public awareness and sensitization.

G Transport

Increase of cycling routes

This measure focuses on increasing the bicycle lane available in the municipality, it is an improvement for cyclists because they can ride through the city without risking their lives or hindering traffic. This action includes the creation of a bicycle lane from Sant Antoni to



Ca Coix by the Consell Insular. The shortest distance is 13.2 km, so the estimated bike lane length is 20 km.

· · · · · · · · · · · · · · · · · · ·	-2			LOCATION
Can Colix	ď٥ _	Cycling Routes		BALEARES
	[1] Number of inhabitants in the mun	Inhabitants		
Santa Agnes	[1] Number of Innabitants in the mun	km		
de Corona - de Albarca	[2] Distance of built-up cycleway	20		
Rig 26 min	[3] gCO2 emissions generated	108187.864		
	[4] gCO2 emissions saved	856214588.066		
26 min 13.4 km				
E 27 min 152 km	Energy sav	ring (kWh/Year)	0.000	
語書のあるので、「「「	CO2 emiss	sions saved per year (kgCO2 eq)	856106.400	

Figure 41. Calculation of the cycling route for Sant Antoni de Portmany. Source: https://www.google.es/maps/?hl=es

• Network of EV recharging points

Another transport-related measure is the inclusion of electric vehicle charging points. In this case, the municipality of Sant Antoni plans to introduce 13 recharging points, and has already installed 5. Therefore, there is the possibility of introducing 8 more, and consequently, it translates into the reduction of emissions that means that citizens can use EVs instead of conventional ones.

tæ	Network of EV rec	harging points
[1] Number of chargers installed	8	7
[.]	-	Standard charger
[2] Charger power (kW)		20
[3] Power supplied by charger (kWh)	29200	1
[4] Electric vehicle consumption (passenger	0.200	
[5] Cars supplied		40
[6] allowable km		Default Value 146000
Energy saving (kW	/h/Year)	0.000
CO2 emissions say	ved per year (kgCO2 eq)	2931680.000

Figure 42. Introduction of EV recharging points in Sant Antoni de Portmany

• Measures to promote public transport and reduce private vehicle use Finally, measures to promote public transport are proposed. To this end, some measures include the introduction of low emission and reduced speed zones, as well as the introduction of bonuses for young people and senior citizens, and an increase in the frequency of public transport.



F	Please select the mea	sures ap	plied in the promotion of	ublic transpo
	Share CO2 savings	Apply	Emissions saved by municipality (kg of carbon dioxide)	
Reduced Speed Zones	25%	x	0.25	
Increase in the frequency of PT passage	10%	x	0.10	
Reducing fees for Youth and Pensioners	5%	x	0.05	
Ecozone (ZBE)	97%	х	0.98	
Tolls (depending on rush hour or not)	30%		0.00	
Congestion charging (reducing the number of cars entering the city	20%		0.00	
		TOTAL	1.38	

Figure 43. Promotion of public transport in Sant Antoni de Portmany

G Awareness

• Awareness-raising information stands

Lastly, to raise public awareness, awareness-raising measures are proposed, such as:

- Awareness campaigns for young people in schools
- Tax rebates on building permits for renewables.
- Recycling campaigns and workshops
- Creation of a communication and awareness plan for energy savings

\checkmark	Select the activ	ons you plan to i	mplement in you	ur municipality		
1	Communication, training and awareness- raising plan	Apply X				
2	Environmental school for school groups	x				
3	Collection of special waste at Puntos Limpios (recycling centres)	x				
4	Bonuses for self-consumption:					
	IBI (property and real estate tax)					
	ICIO (Construction and works tax)	х				
	IAE (Business Activity Tax)					
	Municipal Fees					
5	Responsible energy consumption strategies	x				
	Energy saving (kWh/Year)			33554.323		
	CO2 emissions saved per ye	ar (kgCO2 eq)		77220.413	2	

Figure 44. Awareness-raising information stands in Sant Antoni de Portmany



3.1.2.3. Multicriteria Decision in Sant Antoni

Once the relevant calculations have been made in relation to the actions implemented in the municipality, the last tool is the decision-making module that allows the evaluation of the different actions according to the municipal casuistry.

Using the *Super Decisions* software, priorities are entered at each level, prioritizing among the criteria: technical, economic, social, ecological and political impact. Another prioritization will then be made among the different indicators that will result in the order of priority of the proposed actions at the municipal level.

Considering the priorities established by the municipality, the criteria used to prioritize the different levels are as follows:

- Raise awareness and educate citizens about climate change.
- Promote energy efficiency and the use of renewable sources.
- Encourage responsible resource management
- Design a sustainable and efficient municipality

Taking all this into account, the valuations are introduced in the chosen software applying the AHP method and a final report suitable for the municipality of Sant Antoni de Portmany is obtained.

Alternative Rankings

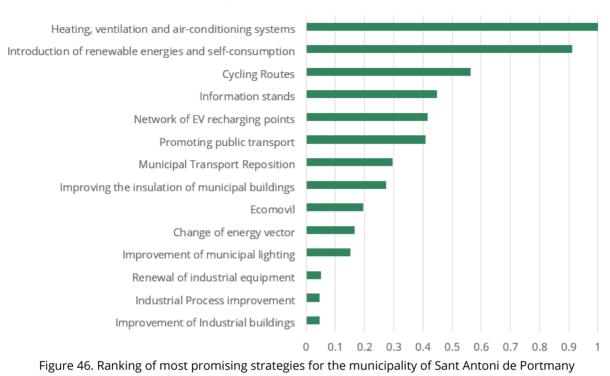
Graphic	Alternatives	Total	Normal	Ideal	Ranking
	CA1.1 Improving the insulation of municipal buildings	0.0181	0.0549	0.2733	8
	CA1.2 Improvement of municipal lighting	0.0101	0.0306	0.1522	11
	CA1.3 Heating, ventilation and air-conditioning systems	0.0664	0.2008	1.0000	1
	CA1.4 Introduction of renewable energies and self-consumption	0.0605	0.1831	0.9118	2
	CA1.5 Municipal Transport Reposition	0.0197	0.0596	0.2967	7
	CA2.1 Industrial Process improvement	0.0031	0.0094	0.0469	13
	CA2.2 Renewal of industrial equipment	0.0034	0.0104	0.0517	12
	CA2.3 Improvement of Industrial buildings		0.0093	0.0461	14
	CA2.4 Change of energy vector		0.0333	0.1656	10
	CA3.1 Cycling Routes	0.0373	0.1130	0.5626	3
	CA3.2 Network of EV recharging points	0.0277	0.0837	0.4169	5
	CA3.3 Promoting public transport	0.0272	0.0823	0.4100	6
	CA4.1 Ecomovil	0.0130	0.0394	0.1962	9
	CA4.2 Information stands	0.0298	0.0902	0.4490	4

Figure 45. Report on alternatives obtained for the municipality of Sant Antoni de Portmany

Finally, the ranking of the most valued alternatives taking into account the municipal casuistry is as follows:



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Ranking of measures in Sant Antoni

3.1.2.4. Ranking of the most promising strategies in Sant Antoni

In summary, the most promising strategies for the municipality of Sant Antoni de Portmany are presented with the associated energy savings and emissions mitigation results. This would be the report provided by the GENERA tools for policy makers according to the defined actions and their evaluation criteria.

PRIORITY	ACTION	ENERGY SAVINGS (MWh/year)	CO ₂ SAVINGS (tCO2e)	CATEGORY
1	Heating, ventilation and air-conditioning systems-	16.23	7.51	Municipal facilities
2	Introduction of renewable energies and self- consumption	56.10	25.24	Municipal facilities
3	Cycling Routes	-	856.10	Transport
4	Information stands	33.55	77.22	Awareness
5	Network of EV recharging points	-	2931.68	Transport
6	Promoting public transport	-	37.86	Transport
7	Municipal Transport Reposition	-	18.93	Municipal facilities
8	Improving the insulation of municipal buildings	1056.95	475.63	Municipal facilities
9	Ecomovil	-	-	Awareness
10	Change of energy vector	-	-	Industry

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PRIORITY	ACTION		ENERGY SAVINGS (MWh/year)	CO ₂ SAVINGS (tCO2e)	CATEGORY
11	Improvement of municipal lighting		1.95	0.88	Municipal facilities
12	Renewal of industrial equipment		-	-	Industry
13	Industrial Process improvement		-	-	Industry
14	Improvement of Industrial buildings		-	-	Industry
		TOTAL	1164.78	4430.95	

Table 3. Most promising strategies in Sant Antoni and estimated associated energy and emissions reductions

Although the ranking of measures includes actions such as those related to the industry sector, these have not been considered in the plan due to the fact that in the short term there are no plans to take measures in this area. However, some measures such as the change of energy vector may be of interest from the municipality due to the need to introduce renewable energies in the municipality. This is why this measure is ahead of the improvement of lighting. It could be considered as an improvement in a future edition of the tool.

3.1.3. Pilot 2 in Tenerife (Canary Islands): El Rosario

3.1.3.1. Features of El Rosario

The municipality has a total of 17,983 inhabitants and its municipal area covers an area of 39.43 square kilometers. It occupies an intermediate position with respect to the size of the rest of the municipalities of the Island (it is larger than 12 of the 31 municipalities of Tenerife) it has a population density of 276 inhabitants per square kilometer [4]. Among its characteristics, the confluence of two very different climates, product of the morphological conditions of the municipality, and the action or absence of the regime of the trade winds, have been decisive for the conformation of its models of development throughout time.

The city council of El Rosario (Tenerife) signed on May 15, 2013 the adhesion to the Covenant of Mayors. The main commitments they assumed were:

Section	Objective
CO ₂ emissions	Reduce CO_2 emissions, in their respective territorial areas, by at least 20%, through the implementation of a Sustainable Energy Action Plan.

Table 4. Municipal objectives of El Rosario

3.1.3.2. Summary of actions of El Rosario

After a detailed study of the actions included in the municipality of El Rosario at the municipal level and, specifically, in the Covenant of Mayors for Climate and Energy, for the



creation and updating of the Action Plan [5], the measures are introduced in the GENERA tool for the evaluation of alternatives. The actions have been considered according to the different sections detailed in the inference module.

G Municipal Buildings And Public Facilities

• Improving energy efficiency in municipal buildings

It is proposed to improve the energy efficiency of buildings, specifically of a total of 7. To this end, the tool allows improving the building envelopes such as windows an insulation. In relation to the windows, a change with double glazing is proposed, which will improve the energy consumption of the buildings. An average of 600 square meters per building is estimated, with 12% of windows. On the other hand, glass wool is added to the insulation on different surfaces.

WINDOWS		
	Select from the list	Enter manual Default va
[1] Current windows	Frame improvement	[1] Transmittance (¥/m2K) 3.2
[2] New windows	Double glazing b	[2] Transmittance (¥łm2K) 18
Surface to be replaced (Enter manual Default value 504 0.012	
	Energy saving (k∀h/Year) ssions saved per year (kgCO2 eq)	559986.739 447989.391
INSULATION	Select from the list	Select from the list Default va
[1] Current Isolation	Insulating Brick	[1] Material conductivity (¥/mC 0.15
Is the insulation	Replacement YES	[1] Insulation thickness (m) 0.04
replaced or added to the existing insulation?	Added NO	
[2] Insulation New	Glass Vool	Select from the list [2] Material conductivity (¥/m) [3]
Surface to be replaced (Enter manual Default value	[2] Insulation thickness (m) 0.06
Ceilings (m2)	4200 0	
Valls (m2)		
Usable surface		
Energy saving (CO2 emissions	saved per year (kgCO2 eq)	15019.20375 IZD 12015.363

Figure 47. Improving the envelope of El Rosario's public buildings

• Indoor lighting renovation



Improved energy efficiency in public buildings by changing luminaires for LEDs, and in streets, incandescent lamps for LEDs in traffic lights.

Ű		Improvement	of municipal lighting			
BUILDINGS						
	Select from the list			Enter manual		Default valu
[1] Current Bulbs	Incandescentes		[1] Maz. Power (¥)			40
[2] New Bulbs	LEDs		[2] Maz. Power			9
	Enter manual			Enter manual	Default value	
Number of luminaires to be replaced	30		Hours of use (h) [SUMMER].		7.5	
STREETS						
	Select from the list			Enter manual		Default valu
[1] Current Bulbs	Sodium AP (HPS)		[1] Max. Potencia (¥)			50
[2] New Bulbs	LEDs		[2] Max. Potencia (W)			33
	Enter manual			Enter manual	Default value	
be replaced	70		Hours of use (h) [SUMMER].	0	10	
berepidoed	10		Hours of use (h) [VINTER].	ů O	14	
Energy saving (k	₩hfYear)		5322.15			

Figure 48. Change of lighting fixtures in public buildings and streets in El Rosario

• Improvement of building conditioning

Among the proposals of the city council is the improvement of the energy efficiency of the buildings, for which the improvement of the air conditioners is proposed, improving their energy labeling as shown below.

	Heating, ventilation	and air cond	tioning systems			CAN	RIAS
Current system selected							
3 Heating and cooling	ig in a single system, independent DHW						
Please enter your heating and cooling	demand						
- HEATING							
[1] Current demand (k¥h/şear	Enter manual 0		Default Value	0			
				0			
[2] Useful surface to heat (m2) 90						
Select the heating emitter system							
[3] System	Heat Pump						
[4] Energy label	Select		Default Value A				
	Select						
[5] Type of equipment	Air Conditioning						
[5.1] Type of equipment	Fan Coils						
[5.1] System	idividual split type equipment (individ	dual and blool					
[6] SCOP				3.4			
[7] Coolant used	Other						
R COOLING	Other	Default Value					
R COOLING		Default Value	1350				
		Default Value					
COOLING [1] Current cooling demand (LVMs] [2] Useful surface to cool (m2)	ter manual	Default Value					
ECOOLING [1] Current cooling demand (kVM/s	ter manual	Default Value					
ECOLING [1] Current cooling demand (kVM/g [2] Useful surface to cool (m2) Select the cooling emitter system	ter manual 90	Default Value			(4) Yentilador		ন্থ
COOLING [1] Current cooling demand (LVMs] [2] Useful surface to cool (m2)	ter manual	Default Value			[4] Ventilador [4.1] Tgpe of fan		Ceiling
ECOLING [1] Current cooling demand (kVM/g [2] Useful surface to cool (m2) Select the cooling emitter system	ter manual 90					uption per hour	Ceiling Default Va 0.5
COOLING [1] Current cooling demand (LVM) [2] Useful surface to cool (m2) Select the cooling emitter system [2.1] Energy Label	90 A			i	[4.1] Type of fan		Ceiling Default Va
COOLING Em [1] Current cooling demand (LVMs) [2] Useful surface to cool (m2) Select the cooling emilter system [2:1] Energy Label [3:2] Type of equipment	90 90 A Air Conditioning				[4.1] Type of fan [4.2] Energy consur [4.3] Hours of use	per year	Ceiling Default Va 0.5 Default Va
COOLING [1] Current cooling demand (LVMs [2] Useful surface to cool (m2) Select the cooling emitter system [3:1] Energy label [3:2] Type of equipment [3:3] Type of equipment [3:3] Type of equipment [3:4] SEER	90 90 A Air Conditioning Fan Colls		1350		[4.1] Type of fan [4.2] Energy consun	per year	Ceiling Default V2 Default V2 Default V2 900
COOLING Cooling demand (kVh) (2) Useful surface to cool (m2) (2) Useful surface to cool (m2) Select the cooling emitter system (3.1) Energy label (3.2) Type of equipment (3.3) Type of equipment (2.4) SEER (3.5) Coolant used	90 90 A Air Conditioning Fan Colis Dither		1350		[4.1] Type of fan [4.2] Energy consun [4.3] Hours of use [4.4] Number of far	per year Is	Ceiling Default Va 0.5 Default Va 0.5 00 1
COOLING [1] Current cooling demand (LVMs [2] Useful surface to cool (m2) Select the cooling emitter system [3:1] Energy label [3:2] Type of equipment [3:3] Type of equipment [3:3] Type of equipment [3:4] SEER	90 90 A Air Conditioning Fan Colis Dither		1350		[4.1] Type of fan [4.2] Energy consur [4.3] Hours of use	per year Is	Ceiling Default Va 0.5 Default Va 0.5 00 1
COOLING Cooling demand (kVh) (2) Useful surface to cool (m2) (2) Useful surface to cool (m2) Select the cooling emitter system (3.1) Energy label (3.2) Type of equipment (3.3) Type of equipment (2.4) SEER (3.5) Coolant used	90 90 A Air Conditioning Fan Colis Dither		1350		[4.1] Type of fan [4.2] Energy consun [4.3] Hours of use [4.4] Number of far	per year Is	Ceiling Default Va 0.5 Default Va 0.5 00 1
COOLING Cooling demand (kVh) (2) Useful surface to cool (m2) (2) Useful surface to cool (m2) Select the cooling emitter system (3.1) Energy label (3.2) Type of equipment (3.3) Type of equipment (2.4) SEER (3.5) Coolant used	90 B A Air Conditioning Fan Cols Other S13.31		1350		[4.1] Type of fan [4.2] Energy consun [4.3] Hours of use [4.4] Number of far	per year Is	Ceiling Default Va 0.5 Default Va 0.5 00 1

Figure 49. Calculation of the previous heating and cooling system in El Rosario



LIFE21-CET-LOCAL-GENERA/ Nº 101077073

The same system is then calculated but improving the energy certificate of the air conditioning equipment, as shown in the following figure. It is assumed that the domestic hot water system is independent.

	NEV	V SYSTEM		
Please select the type of system to be used 4 Heating and cooling i	n a single system, independent DHW			
🔆 HEATING				
Select the heating emitter system				
[3] System	Heat Pump			
[4] Energy label	Select A++	Default Value A		
[5] Type of equipment	Select Air Conditioning			
[5.1] Type of equipment	Fan Coils			
	Fan Coils			
[6] SCOP		5.1		
ielect the cooling emitter system			[4] Ventilador	No *
***	A]	[4] Yentilador [4.1] Type of fan	Ceiling
* ielect the cooling emitter system	A Air Conditioning]		Ceiling Default Value 0.5
* [3.1] Energy label]]]	[4.1] Type of fan	Ceiling Default Value 0.5 Default Value
(3.1] Energy label (3.2) Type of equipment	Air Conditioning	5.6	[4.1] Type of fan [4.2] Energy consumption per he	Ceiling Default Value 0.5 Default Value
(3.1] Energy label [3.2] Tape of equipment [3.3] Tape of equipment	Air Conditioning]]] 56	[4.1] Type of fan [4.2] Energy consumption per ho [4.3] Hours of use per gear	Ceiling Default Value 0.5 Default Value 300 htye
(3.1) Energy label (3.2) Type of equipment (3.3) Type of equipment (3.4) SEER	Air Conditioning Fan Coils Other]]] <i>56</i>	[4.1] Type of fan [4.2] Energy consumption per ho [4.3] Hours of use per gear	Celling Default Value 0.5 Cerfault Value 0.5 0 0
	Air Conditioning Fan Coils Other]]] <i>58</i>]	 [4.1] Type of fan [4.2] Energy consumption per ho [4.3] Hours of use per gear [4.4] Number of fans 	Celling Defact Value 0,5 Ceriace Value 900 https://www.ceriace.com/ 900 https://wwwwwwww.ceriace.com/ 900 https://www.ceriace.com/ 900 https://www.ceriace.com/ 900 https://www.ceriace.com/ 900 https://wwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwww
	Air Conditioning Fan Coils Other at) 513.31	56	 [4.1] Type of fan [4.2] Energy consumption per ho [4.3] Hours of use per gear [4.4] Number of fans 	Celling Defact Value 0,5 Ceriace Value 900 https://www.ceriace.com/ 900 https://wwwwwwww.ceriace.com/ 900 https://www.ceriace.com/ 900 https://www.ceriace.com/ 900 https://www.ceriace.com/ 900 https://wwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwww

Figure 50. Calculation of the new heating and cooling system in El Rosario

Finally, the summary of the energy saved by the improvement of the equipment is shown, as well as the emissions saved.

8	Heating, ven	tilation and air conditioning syst	ems	
	est suits your current system : ooling in a single system, independent l	DHW		
Click on the number that option:	corresponds to the chosen		3 4	
Ener	rgy Consumption k∀h/Year)		963.31	
CO2	: Emissions (gCO2 eq)		770.646	,
		NEW SYST	EM	
Please select the type o				
	leating and cooling in a single system, i		34	
3	leating and cooling in a single system, i		513.31 410.646	

Figure 51. Energy and CO₂ emissions savings from improved air conditioning in El Rosario



• Introduction of renewable energies in public buildings

Among the main actions proposed at the municipal level are the installation of solar thermal energy in municipal buildings, according to the square meters available, and the installation of solar photovoltaic energy.

The first step is to enter the data of the buildings, and the information to enter the solar thermal energy considering the available area of the collectors.

*	1	Introduction o	f renewable energies	and self-c	onsump	otion				
DATA										
5	Relect from the list									
[1] Type of building	Public Utility E	Buildings	No. of workers	25		Unit consum	ption of I	DH¥ (I/day)		5
[2] Usable surface	1200]							
			Default value							
[3] Hours of use			8							
[4] Annual electrical demand of the building (k∀h)			70080							
SOLAR THERMAL Daily consumption	(m3ic)	Solar	Thermal Energy?	YES		Useful surface (m2)		22	1	1
Dany consumption	(mors)					oserar sarrace (mz)		22		
DHV demand (KVh	dyear)		887.7							
Storage tank (L)		50	1		Default va	مىقد		Default value		
Type of solar colle	ctor	Flat Collector	Performance(%)	Ĺ	0.68	Collector area	2			
Generated power (I	k ∀)/ Collector	12.85	Total Power Genera	ated (k¥)		12.85				
Total Energy Gener	rated	26059.65]							
Energy savings (k)					26059.65					
CO2 emissions sa	ved per year (kgCO2	2 eq)		2	20847.721	2				

Figure 52. Installation of solar thermal energy in municipal buildings in El Rosario.

On the other hand, solar energy is also introduced for electricity production. In this case, monocrystalline panels with higher efficiency and 40W power are used. The use of batteries for energy storage is not analyzed.

Finally, it is also intended to better manage municipal composting through the use of prunings. A quantity of prunings of 1000kg is foreseen for use in the anaerobic digester.



PHOTOVOLTAIC	Solar Er	nergy System?	Batteries for storage? Surplus compensat	ND
Building energy consumption		70080		
			Default Value	Default Value
Types of solar collector	Monocrystalline P	erformance (%)	0.23 Collector size (₩)	40 200
Power generated (kWh)	2883.96793		Number of collecto	rs 1
Battery capacity (Ah)		0		
Stored Energy (kWh)				
Energy savings (kWh/Year)			67196.03	
CO2 emissions saved per year (k	aC()2 oa)		53756.826	
CO2 emissions saved per year (k	.gc.oz.eq)	I	33130.020	
BIOMASS	Anaerobic			
Kg of waste per day	1000			f organic waste Kg
Percentage of organic waste (%)		50%	Animal origin Plant origin	1000
			Human origin	
Organic mass (kg per day)	500		Agro-industr	ial
	100		Forestry	
Volume of Methane generated (C	:H4) 129		Aquatic Crop	s
Reactor recovery efficiency (%)		60%		
Volume of methane available	77			
Energy generated (k¥hłday)	33			
Energy savings (k¥h/Year)			11926.32	
CO2 emissions saved per year (k	gCO2 eq)		9541.056	

Figure 53. Photovoltaic and biomass solar energy installation in El Rosario

• Renewal of municipal fleet of energy efficient vehicles

Finally, the last action considered at the municipal level is to renew the fleet of vehicles for more efficient ones, such as electric vehicles. In this case, all gasoline vehicles (a total of 10 vehicles) will be replaced by electric vehicles.

Number of vehicles withdrawn	10	 Default Value		
Average travel distance per vehicle per year		28.9	CO2 emissions per vehicle per country (kgCO2/year)	949
		Default Value		
Electricity consumption of a E¥		0.2		
No. of new electric vehicles	10		CO2 emissions per vehicle per country (kgCO2/year)	5

Figure 54. Replacing vehicles with more efficient ones in El Rosario

G Industry

Promotion of energy consumption control in companies, e.g. industrial air conditioning with EC (electronically commuted) fans.



Incentive lines	se i	5				
Renewal of equipment						
Change of energy vector						
Industrial buildings						
Process improvement						
	Pleas	se select below the acti	ons that you con	sider of interest to	implement:	
Incentive lines	Pleas	se select below the acti	Energ	sider of interest to Electric ener savings	implement: Ratio (investment/savin	Emissions tCo2/year
Incentive lines	T		Energy savings (: ¥	Electric ener	Ratio	

Figure 55. Improving energy efficiency in businesses in El Rosario

G Transport

• Increased bicycle lane line

Among the main actions is the creation of a mobility plan for the improvement of municipal transportation. This plan indicates the km of bike lanes to be extended, in this case it is proposed to include 5 km of lanes that will save CO₂ emissions according to the figure below.

65	Cycling Routes		LOCATION CANARIAS
	Inhabitan	ns	
[1] Number of inhabitants in the municipali			
	km		
[2] Distance of built-up cycleway	5		
		_	
[3] gCO2 emissions generated	17731.238		
[4] gCO2 emissions saved	35081903.087]	
Energy saving (k	∀h/Year)	0.000	
CO2 emissions s	aved per year (kgCO2 eq)	35064.172	🍰

Figure 56. Emissions saved by the inclusion of bike lanes in El Rosario

• Implementation of alternative recharging points

Including recharging points to provide alternative options to conventional vehicles is another priority action. In this case, it is proposed to introduce 2 electric vehicle recharging points.



t er	Network of EV rechar	ging points
		_
[1] Number of chargers installed	2	
103 6 1 (1110		Standard charger
[2] Charger power (kW)		20
[3] Power supplied by charger (kWh)	29200	2
[4] Electric vehicle consumption (passenger cars) (kWh/km)	0.200	
		Default Value
[5] Cars supplied		10
		Default Value
[6] allowable km		146000
Energy saving (kW	h/Year)	0.000
CO2 emissions sav	ved per year (kgCO2 eq)	712480.000

Figure 57. Creation of EV recharging points in El Rosario

• Actions to promote public transport

Finally, some measures to promote public transport are introduced to help citizens become aware and take action. Some actions are the improvement of public transport by increasing frequency, reduced rates for young people and adults or the creation of a low emission zone.

\checkmark	Please select the measu	ires appli	ed in the promotion of pub	lic transport:	
	Share CO2 savings	Apply	Emissions saved by municipality (kg of carbon dioxide)		
Reduced Speed Zones	25%		0.00		
Increase in the frequency of PT passage	10%	×	0.07		
Reducing fees for Youth and Pensioners	5%	×	0.03		
Ecozone (ZBE)	97%	×	0.64		
Tolls (depending on rush hour or not)	30%		0.00		
Congestion charging (reducing the number of cars entering the	20%		0.00		
		TOTAL	0.74		
		TOTAL	0.74		

Figure 58. Actions to promote public transport in El Rosario

G Awareness

Citizen awareness actions in El Rosario are directly aimed at the creation of a municipal awareness and training plan. They also include training in schools, collection points and



training workshops for recycling and energy consumption reduction strategies. In addition, discount rates are also applied for homes with self-consumption or for construction works with bioclimatic solutions. The following figure shows the different measures with the consequent energy savings and emissions mitigated by their application.

	· · · ·	Information stands
\checkmark	Select the actio	ions you plan to implement in your municipality
		Аррју
1	Communication, training and a v areness-raising plan	×
2	Environmental school for school groups	x
3	Collection of special waste at Clean Points (recycling centres)	×
4	Bonuses for self-consumption:	
	IBI (property and real estate tax)	x
	ICIO (Construction and works tax)	
	IAE (Business Activity Tax)	
	Municipal Fees	
5	Responsible energy consumption strategies	x
	Energy saving (k¥h/Year)	33973.919
	CO2 emissions saved per g	year (kgCO2 eq)

Figure 59. Citizen awareness measures in El Rosario

3.1.3.3. Multicriteria Decision in El Rosario

Considering the priorities established by the municipality, the criteria used to prioritize the different levels are as follows:

- Conducting energy audits in municipal buildings and schools.
- Improvements in the equipment and infrastructure of the public lighting network, through the replacement of more efficient switchboards, luminaires and lamps.
- Municipal tax rebates for the use of renewable energies and energy efficient vehicles.
- Use of renewable energies: use of biogas energy generated by the contribution of waste at the provincial landfill, installation of photovoltaic plants and solar thermal installations.
- Intention to set up a permanent personalized attention and advice department for individuals and legal entities interested in energy saving and the use of renewable energy sources.



The assessments are introduced in the chosen software applying the AHP method and a final report is obtained, suitable for the municipality of El Rosario.

Alternative Rankings

Graphic	Alternatives	Total	Normal	Ideal	Ranking
	CA1.1 Improving the insulation of municipal buildings	0.0183	0.0558	0.2764	8
	CA1.2 Improvement of municipal lighting	0.0262	0.0799	0.3959	6
	CA1.3 Heating, ventilation and air-conditioning systems	0.0342	0.1043	0.5169	4
	CA1.4 Introduction of renewable energies and self-consumption	0.0661	0.2017	1.0000	1
	CA1.5 Municipal Transport Reposition	0.0081	0.0246	0.1220	10
	CA2.1 Industrial Process improvement	0.0035	0.0107	0.0529	14
	CA2.2 Renewal of industrial equipment	0.0039	0.0119	0.0590	12
	CA2.3 Improvement of Industrial buildings	0.0036	0.0109	0.0539	13
	CA2.4 Change of energy vector	0.0082	0.0251	0.1242	9
	CA3.1 Cycling Routes	0.0376	0.1146	0.5683	3
	CA3.2 Network of EV recharging points	0.0230	0.0702	0.3478	7
	CA3.3 Promoting public transport	0.0276	0.0842	0.4174	5
	CA4.1 Ecomovil	0.0057	0.0173	0.0855	11
	CA4.2 Information stands	0.0620	0.1890	0.9371	2

Figure 60. Report on alternatives obtained for the municipality of El Rosario

Finally, the ranking of the most valued alternatives taking into account the municipal casuistry is as follows:

Ranking of measures in El Rosario





3.1.3.4. Ranking of the most promising strategies in El Rosario

In summary, the most promising strategies for the municipality of El Rosario are presented with the associated energy savings and emissions mitigation results. This would be the report provided by the GENERA tools for policy makers according to the defined actions and their evaluation criteria.

PRIORITY	ACTION	ENERGY SAVINGS (MWh/year)	CO₂ SAVINGS (tCO₂e)	CATEGORY
1	Introduction of renewable energies and self-consumption	105.18	84.15	Municipal facilities
2	Information stands	33.94	89.30	Awareness
3	Cycling Routes	-	35.06	Transport
4	Heating, ventilation and air-conditioning systems	0.45	0.36	Municipal facilities
5	Promoting public transport	-	13.30	Transport
6	Improvement of municipal lighting	5.32	4.26	Municipal facilities
7	Network of EV recharging points	-	712.50	Transport
8	Improving the insulation of municipal buildings	567.45	453.96	Municipal facilities
9	Change of energy vector	-	-	Industry
10	Municipal Transport Reposition	-	9.45	Municipal facilities
11	Ecomovil	-	-	Awareness
12	Renewal of industrial equipment	46.52	37.22	Industry
13	Improvement of Industrial buildings	-	-	Industry
14	Industrial Process improvement	-	-	Industry
	TOTAL	758.86	1439.20	

Table 5. Most promising strategies in El Rosario and estimated associated energy and emissions reductions

In this case, the municipal measures are mainly obtained first, together with those of awareness and transportation. In the last place are those related to industry, although there are measures related to the renewal of equipment in the tertiary or industrial sector. The energy vector appears after making the comparison in the AHP for including renewable energies and other non-conventional systems in the process, and these are municipal priorities, even though they are not included as specific actions.



3.2. Italy

Italy, like Spain, is characterized by lower per capita electricity consumption and lower mineral depletion, and its electricity generation from renewable sources is very similar, at around 45% [1].

In relation to the situation of the Italian islands, Sicily is characterized by a large population that contrasts with a low population density (larger territory). Its employability rate is low and its economy is less dependent on tourism than in other Mediterranean regions. The island of Sardinia is characterized by a low population and population density, which translates into a good employment rate; however, it is not highly dependent on tourism.

3.2.1. Study of the Italian National Context

This section presents an analysis of the energy context of Italy using module 1 of the GENERA tool. As in the case of Spain, the reference data are taken from the year 2023, which is the year for which complete information is available. The Italian energy mix for energy supply is mainly characterized by natural gas (38.1%) with values similar to oil (37.5%), followed by biofuels and waste (10.5%) and continued by geothermal, solar and wind energy, coal and hydropower. CO₂ emissions in Italy have been reduced by 26% compared to 2000 data, making Italy an emitter of 0.91% of world emissions.

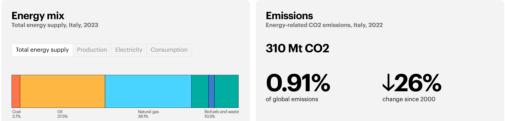


Figure 62. Summary of Italy's energy mix and emissions. Source: <u>https://www.iea.org/countries/italy</u>

Using Module 1 of the GENERA tools, 2022 reference data are introduced (since 2023 is incomplete for some sectors) and come from the International Energy Agency [1].

Figure 63 shows the contribution of each energy source in the main sectors of the Italian economy such as transport, industry, residential, services and others (agriculture, fishing, etc.), including electricity generation.

In Italy, the use of fossil fuels such as oil stands out, mainly for the transport and agriculture/fishing sectors, and natural gas for the industrial, residential and services sectors, as well as electricity generation. In addition, there is also special relevance of renewables in the residential sector. On the other hand, they have practically no coal and no contribution from nuclear energy.



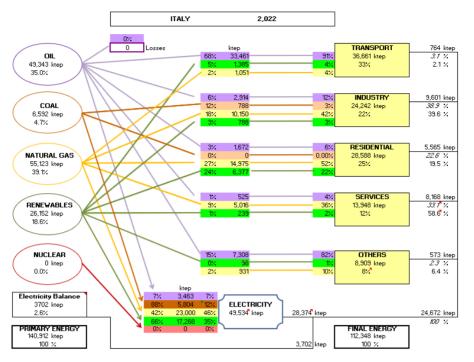


Figure 63. Energy balance of the different energy sources and sectors in Italy

The main indicators such as primary energy demand, electricity generation and emissions up to 2030, following current trends, are presented in the following figures.

Figure 64 below shows the data on primary energy demand in the current Italian system. As can be seen in the figure, the contribution is very stable over the years, with the main involvement of natural gas and oil. This is followed by renewables and coal and nuclear. The figure shows a subtle increase in natural gas and renewables, which could be increased by implementing sustainable policies.

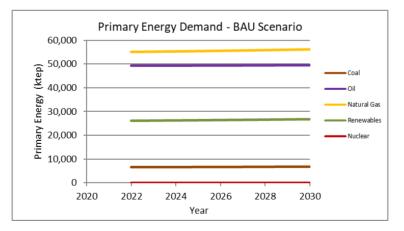


Figure 64. BAU Italy Scenario: Primary Energy Demand

The figure below shows the contribution of each source to Italy's electricity generation, which is mainly based on natural gas followed by renewable energy. These are the main sources of electricity production. Also noteworthy is the growing generation by renewable energy, which will continue to grow and, if measures are implemented, could even



increase. The next sources that contribute to a lesser extent are coal and oil. Finally, there is no contribution from nuclear energy in Italy.

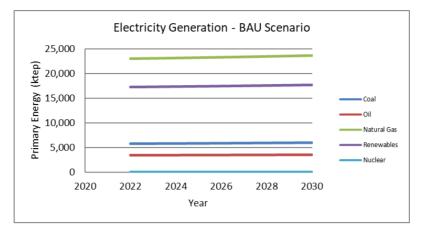


Figure 65. BAU Italy Scenario: Electricity Generation

Finally, the CO₂ emissions produced in Italy by each sector are shown. The main CO₂ emitting sector is electricity generation, which may be due to the 12% contribution of coal, so implementing measures to reduce it is of vital importance. This is followed by the transport sector, which could be reduced through the promotion of public transport, low emission zones, etc. The remaining emissions are mainly produced by the residential sector. Over the years, a small decreasing trend in terms of emissions can be observed in the industry and agriculture and fishing sectors. The sector that contributes the least is the services sector.

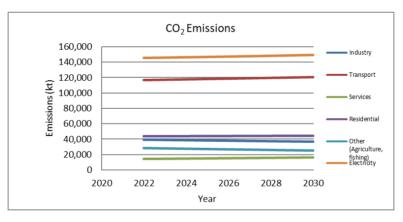


Figure 66. BAU Italy Scenario: CO₂ Emissions

In summary, the Italian energy context is characterized by the use of natural gas and oil mainly, whose major contribution is divided between the transport and electricity generation sectors, which generate most of the country's emissions. However, they are involved in all sectors: industry, residential, services and agriculture and fishing. Renewable energies are more involved in the residential and electricity sectors. In addition, there is a growing trend in the use of renewable energies, mainly for electricity production. Natural gas also shows a growing trend and greater participation in the



industrial, electricity generation, residential and services sectors. Finally, in terms of emissions, the most damaging sector is electricity generation, followed by transportation. Creating and implementing measures that encourage the use of renewable energy for electricity generation and for the transportation sector could be a goal to reduce emissions in the coming years.

3.2.2. Pilot 3 in Sardinia: Stintino

3.2.2.1. Features of Stintino

Stintino is a town in the Italian province, region of Sardinia, with 1,212 inhabitants [6]. Stintino is classified as a Climate Zone C, it is a fairly warm zone. The province of Sassari has on average 82.22 hot days (temperatures above 30°C) and 0.31 cold days (temperatures below 5°C) per year. It rains (or snows) approximately 81.12 days per year. There is very little fog during the year. Stintino receives approximately 8.2 hours of sunshine per day.

The municipality of Stintino joined the Covenant of Mayors initiative with the main objective of reducing CO_2 emissions by 20%. However, the planned actions are subdivided into the different sectors of construction, mobility, renewable energies and public awareness processes.

Section	Objective
Construction	Actions planned in relation to new buildings and the increase of existing buildings with higher performance. In addition, interventions will be carried out in sub-sectors (public and private, schools and tertiary sectors).
Mobility	Improvement of accessibility conditions in the urban area: transportation methods, bicycle lanes and pedestrian areas.
Renewable Energy	Reduced dependence on conventional energy sources.
Awareness	Implementation of awareness, training and citizen participation processes to improve sustainability and education in terms of energy consumption.

Table 6. Main sections and areas for improvement at Stintino

3.2.2.2. Summary of actions of Stintino

After a detailed study of the actions included in Stintino at municipal level and, specifically, in the Covenant of Mayors for Climate and Energy, for the creation and updating of the Action Plan [7], the measures are introduced in the GENERA tool for the evaluation of alternatives. The actions have been considered according to the different sections detailed in the inference module.



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G Municipal Buildings And Public Facilities

In the case of Stintino, most measures are proposed in relation to municipal buildings. This gives rise to further improvements in the tool, as it is necessary to apply each of the measures per building, so an improvement could be made that applies individually to each building, and then everything could be aggregated on a single platform.

Below is a sample of what would be the implementation of measures for one of the proposed buildings, since in many cases it is intended to implement improvements in insulation, lighting, introduction of renewables and air conditioning in different buildings in parallel.

• Improving energy efficiency in municipal buildings

It is proposed to improve the external insulation of the municipal library by renovating the building, adding an external cladding with 7 cm of insulation and 0.032 W/mK of thermal conductivity.

INSULATION				
[1] Current Isolation	Select from the list Insulating Brick		Select from the list Default [1] Material conductivity (W/mC)	t <i>value</i> 0.1
Is the insulation replaced or added to the existing		-	[1] Insulation thickness (m)	0.01
insulation? [2] Insulation New	Added NO Glass Wool		[2] Material conductivity (W/mC) 0.34	0.08
	Enter manual	Default value		0.07
Surface to be replaced (m2) Ceilings (m2) Walls (m2)	200	0		
Usable surface				
Energy saving (kW				
CO2 emissions sav	ed per year (kgCO2 eq)		646.811	

Figure 67. Improving insulation of public buildings in Stintino

• Substitution Of Lights For More Efficient Ones

Another of the actions to be implemented is the revision of the interior lighting, introducing more efficient ones and, if possible, introducing motion sensors. In this case, LED lights are proposed as they are the most efficient, and the possibility of introducing twilight sensors is considered. Also, sodium vapor lamps in public lighting are being replaced with more efficient LED lamps.



		Improver	ment of munici	pal light	ing			
BUILDINGS	Select from the list					Enter manual		Default value
[1] Current Bulbs	Incandescentes				[1] Max. Power (W)			40
[2] New Bulbs	LEDs				[2] Max. Power			9
Number of luminaires to be replaced	Enter manual 30				Hours of use (h) [SUMMER].	Enter manual	Default value 7.5	
STREETS								
	Select from the list					Enter manual		Default value
[1] Current Bulbs	Sodium AP (HPS)				[1] Max. Potencia (W)			50
[2] New Bulbs	LEDs				[2] Max. Potencia (W)			33
	Enter manual					Enter manual	Default value	
replaced	280			*	Hours of use (h) [SUMMER].	0	12	
				\$	Hours of use (h) [WINTER].	0	20	
Energy saving (kWh	h/Year)		. [27598.95			
CO2 emissions save	ed per year (kgCO2 eq)		!!		12336.731			

Figure 68. Improvement of luminaires in buildings and streets in Stintino

• Improvement of building conditioning

In relation to air conditioning, it is proposed to modify the current system in different buildings, including the gymnasium and public schools. The following is the case of the gymnasium, for which an electric water heater is replaced by a fancoil heating system consisting of a geothermal heat pump. Therefore, in primary instance, they only had an electric heater for DHW, as shown in the following figure:

ACS					
ACS	ls there a DH₩ system?	Yes			
Type of DH¥ heater	Heater				
Domestic Hot Water Dema	nd (DUV) kVkJaan		Default Value 20561.363		
If the value is unknown:	nu (Driw) kwnigear		20061.363		
Type of facility		Gym	Nº workers	50	
Unit DH¥ consumption (I/	201		Default Value 1050		
one offer consumption (in	(45)		Default Value		
Cold Water Temperature (°C)		13.75		
				UEATED	
				HEATER	
				[2.1] Energy label	Unknown
				[2.1] Energy label	Unknown Select
				[2.1] Energy label [2.2] Type of equipment	
				[2.2] Type of equipment	Select Electric Heater
					Select
				[2.2] Type of equipment	Select Electric Heater
				[2.2] Type of equipment	Select Electric Heater
				[2.2] Type of equipment	Select Electric Heater
				[2.2] Type of equipment	Select Electric Heater
				[2.2] Type of equipment	Select Electric Heater
				[2.2] Type of equipment	Select Electric Heater
				[2.2] Type of equipment	Select Electric Heater
				[2.2] Type of equipment	Select Electric Heater
				[2.2] Type of equipment	Select Electric Heater
DHV Consumptio	n (k¥hfYear)			[2.2] Type of equipment	Select Electric Heater

Figure 69. Energy consumption of the current DHW system in a gymnasium in Stintino

The new system has heating and DHW but uses a geothermal heat pump, and is introduced into the system as follows:



*	HEATING			
Select	the heating emitter system			
	[3] System	Heat Pump Select	Default Value	
	[4] Energy label	A++ Select	4	
	[5] Type of equipment	Geothermal energy closed loop (horizontal)]	
	[5.1] Type of equipment	Fan Coils		
	101 0000			5.1
	[6] SCOP			5.1
	[7] Coolant used	Other		
	ACS			
	HEATER			
	[2.1] Energy label	A++ Select	0	
	[2.2] Type of equipment	Geothermal energy closed loop (horizontal)]	
	[2.4] SCOP	5.1	5.1	
	Heating Consumption (kVh/	Year)		5039.453504
	CO2 Emissions (gCO2 eq)			2252.635716

Figure 70. Energy consumption of the DHW and heating system in Stintino

Finally, the energy savings and emissions mitigated with both systems are calculated:

	Heating, ventilation and air condit	ioning systems		
	on that best suits your current system: ing, cooling and DHW in independent systems			
Click on the nur option:	mber that corresponds to the chosen	3 4		
	Energy Consumption kWh/Year)		20561.36	r
	CO2 Emissions (gCO2 eq)		9190.929	
	NEW	SYSTEM		
	ne type of system to be used	SYSTEM		
Please select th		SYSTEM		
2	ne type of system to be used	SYSTEM		
2 Click on the num	ne type of system to be used Heating and DHW in one system, independent cooling	3 (5039.45	
2 Click on the num	ne type of system to be used Heating and DHW in one system, independent cooling mber that corresponds to the chosen	SYSTEM	5039.45 	
2 Click on the nun option:	he type of system to be used Heating and DHW in one system, independent cooling Inber that corresponds to the chosen Inber that corresponds to the chosen Inber that corresponds to the chosen	3 (

Figure 71. Energy saved by changing the air conditioning and DHW system of Stintino's buildings



• Introduction of renewable energies in public buildings

Another of the actions implemented in the gymnasium was the introduction of a solar thermal system for the production of DHW with a surface area of 10m2 and a 500-liter storage tank.

*	Introductio	on of renewable energies	s and self-consum	ption		
DATA						
Sele	ect from the list					
[1] Type of building orts	center, indoor pavilion and heated swim	ming p No. of workers	25	Unit consumpti	ion of DHW (l/day)	525
[2] Usable surface	10					
		Default value				
[3] Hours of use		20				
[4] Annual electrical demand of the building (kWh)		2190				
SOLAR THERMAL Daily consumption (m3)		Solar Thermal Energy? 0.0000058	YES	Useful surface (m2)		
Daily consumption (m3)	/\$)	0.000058		Useful surface (m2)	10	7
DHW demand (KWh/yea	ar)	9883.6				
Storage tank (L)	500					
Type of solar collector	Flat Collect	or Performance(%)	Default va 0.68	Collector area	0 2	
Generated power (kW)/	Collector 1.04	Total Power Generate	d (kW)	4.18]	
Total Energy Generated	10978.72					
Energy savings (kWh/Ye	ear)		10978.72			
CO2 emissions saved pe	r year (kgCO2 eq)		4907.490	2		_

Figure 72. Introduction of solar thermal energy in Stintino public buildings

In relation to photovoltaic solar energy, energy savings of approximately 260 MWh/year are estimated, which is approximately what is obtained with this system.

PHOTOVOLTAIC	Sola	r Energy System?		Batteries for storage? Surplus compensation	NO n	
Building energy consumption (kWh/year)	3000	2190				
				ult Value		Default Va
Types of solar collector	Monocrystalline	Performance (%)	0.	23 Collector size (W)	400	200
Power generated (kWh)	257773.512]		Number of collectors	10	1
Battery capacity (Ah)		0				
Stored Energy (kWh)]				
Energy savings (kWh/Year)			2547	73.51		
,						
CO2 emissions saved per year (kgCO2 eq)			11388	33.760		

Figure 73. Introduction of photovoltaic solar energy in Stintino

• Renewal of municipal fleet of energy efficient vehicles

Finally, it is proposed to renew the fleet of municipal vehicles for more efficient ones such as electric vehicles. It is proposed to replace 1 vehicle.



Number of vehicles withdrawn	1	Default Value		
Average travel distance per vehicle per year		35	CO2 emissions per vehicle per country (kgCO2/year)	1157
		Default Value		
Electricity consumption of a EV (kWh/km)		0.2		
No. of new electric vehicles	1]	CO2 emissions per vehicle per country (kgCO2/year)	3
		_		

Figure 74. Introduction of electric vehicles in Stintino

G Industry

In the tertiary and productive sector, measures and promotion of environmental management tools are also introduced to improve industrial buildings.

Accestive lines Example of energy vector Industrial buildings Process improvement Reneval of equipment Please select below the actions that you consider of interest to implement: Increative lines Actinax Actinax Conserved Cons		Disease salest the ind	unter line in whi	ch the measures and	anho			
Change of energy vector Industrial buildings Process improvement Renewal of equipment Process the select below the actions that you consider of interest to implement: Incentive lines Actings Actings Consider of Interest to implement: Exercipy Consider of Interest Exercipy Consider of Int		Please select the ind	usury line in whi	ch the measures a	ppiy.			
Industrial buildings Process improvement Renewal of equipment Process improvement Image: Process improvement </th <th>ncentive lines 🛛 🏂</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>	ncentive lines 🛛 🏂							
Industrial buildings Process improvement Renewal of equipment Process improvement Image: Process improvement </th <th>Change of energy vector</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>	Change of energy vector							
Renewal of equipment Please select below the actions that you consider of interest to implement: Incontine lines Actions Exercise (Construction) Ration (Construction) Emirginant (Construction) Incontine lines Actions Exercise (Construction) Battion (Construction) Emirginant (Construction) Improvements of thermal incursion infraction (Construction) 595.6242476 99.16 Action (Construction) Redections/Heat thick in in Struction (Construction) 595.6242476 97.16	Industrial buildings							
Renewal of equipment Please select below the actions that you consider of interest to implement: Incontine lines Actions Exercise (Construction) Ration (Construction) Emirginant (Construction) Incontine lines Actions Exercise (Construction) Battion (Construction) Emirginant (Construction) Improvements of thermal incursion infraction (Construction) 595.6242476 99.16 Action (Construction) Redections/Heat thick in in Struction (Construction) 595.6242476 97.16	•							
Please select below the actions that you consider of interest to implement: Increative lines Actimas Construct		- 1						
Increative lines Actions Energy exchange Electric const seringe Ratio (investigation action) Emirgy Constraints Ratio Constraints Emirgy Constraints description Instraints 60% 196080.00 998.6262476 99.16 description Relation in fraction chambers 60% 196080.00 998.6262476 99.16 description Relation in fraction in fraction in fraction 20% 1982520.00 595.6262476 99.16								
Increative lines Actimas Energy curings (C) Electric search (construction) Ratio (construction) Ratio (construction) Emergy curings (C) Construction) Emergy curings (C) Construction) Construction (construction) Construction (c) Construction	_							
Improvement of thermal involution in Frazing Covering (Covering Covering Coverin	M Ple	ease select below the action	ons that you con	sider of interest to	implement:			
Construction Reference Reference Construction Construction <thconstruction< th=""> <thconstruction< th=""></thconstruction<></thconstruction<>								
destriel building: involation freesing 60% 186080.00 898.6242476 99.16 chambers Autorial building: Reduction of heat quint in air: 20% 1002200.00 1166 600074 E7 E4	laceative liner 🛛 🖵	Actinur 🔻		Electric ener	Ratin (investment/savi	tCu2/year		
chamberz Anne Reduction of K-ot quint in air 2014 - 4002200 00 446 4000007 E71 E4		Improvement of the real						
Reduction of heat quinz in nir 200 4602200 nn 446 6006074 974 Ed								
	durtrial buildingr	insulation in freezing	60×	186080.00	898.6242476	99.16		
	-	inrulation in freezing chambers						
		inrulation in freezing chambers Reduction of heat gains in air-						
		inrulation in freezing chambers Reduction of heat gains in air-						
	ndurtrial hvildingr	inrulation in freezing chambers Reduction of heat gains in air-						
	· · · · · · · · · · · · · · · · · · ·	inrulation in freezing chamberz Reduction of heat quirr in air- conditioned process halls	20%	1093220.00				•
		inrulation in freezing chamberz Reduction of heat quirr in air- conditioned process halls	20%	1093220.00			1279300.000	Þ

Figure 75. Improvements implemented in the industry at Stintino

G Transport

The actions proposed for Stintino in relation to transportation are the creation of bike lanes to fluidify traffic, the installation of EV charging points as well as measures to promote public transport for citizens.

• Introduction of bicycle lanes

It is proposed to introduce a 5-km bike lane in Stintino to encourage the use of nonconventional means of transport.



ର୍ତ୍ତ	Cycling Route	5		LOCATION SARDINIA		
	Inhab	tants				
] Number of inhabitants in the municipali	1301					
	km					
2] Distance of built-up cycleway	5					
		_				
[3] gCO2 emissions generated	4169.0545					
4] gCO2 emissions saved	26808037.278					
Energy saving (k¥hł)	(ear)		0.000			
Energy Saving (Kunn	-carj		0.000			
CO2 emissions save			26803.868	~ ~		

Figure 76. Promotion of bicycle lanes in Stintino

• Introduction of an EV recharging point

Installing an EV charging point will favor the use of non-conventional vehicles and the reduction of CO₂ emissions.

ĭ⇔,	Network of EV rech	arging points	
[1] Number of chargers installed	1		
[2] Charger power (k¥)		Standard charge 20	r
		20	
[3] Power supplied by charger (kWh)	29200		
[4] Electric vehicle consumption	0.200		
(passenger cars) (k∀hłkm)		 Default Value	
[5] Cars supplied			
[J] Cars supplied		5	
[6] allowable km		Default Value 146000	
		140000	
Energy saving (k)	Vh/Year)	0.000	
CO 2		366547.600	$\neg \Delta$
CU2 emissions s	aved per year (kgCO2 eq)	366547.600	_ Cø

Figure 77. EV Recharging Points in Stintino

• Promotion of public transport in Stintino

At the transport level, it is also proposed to introduce reduced speed zones, as well as to increase the frequency of public transport.



Please select the measures applied in the promotion of public transport:							
	Share CO2 savings	Арріу	Emissions saved by municipality (kg of carbon dioxide)				
Reduced Speed Zones	25%	×	0.01				
Increase in the frequency of PT passage	10%	×	0.00				
Reducing fees for Youth and Pensioners	5%		0.00				
Ecozone (ZBE)	97%		0.00				
Tolls (depending on rush hour or not)	30%		0.00				
Congestion charging (reducing the number of cars entering the	20%		0.00				
		TOTAL	0.01				

Figure 78. Measures to reduce traffic in Stintino

G Awareness

Other measures include raising public awareness, creating communication and awareness plans, workshops for schools and energy consumption reduction strategies. In addition, discount rates for sustainable bioclimatic constructions are also proposed.

	· · · ·	Information stands
\checkmark	Select the action	ons you plan to implement in your municipality
		Apply
1	Communication, training and a v areness-raising plan	×
2	Environmental school for school groups	x
3	Collection of special v aste at Clean Points (recycling centres)	
4	Bonuses for self-consumption:	
	IBI (property and real estate tax)	
	ICIO (Construction and works tax)	x
	IAE (Business Activity Tax)	
	Municipal Fees	
	· · · ·	
5	Responsible energy consumption strategies	×
	Energy saving (k¥h/Year)	gear (kgCO2 eq)
	CO2 emissions saved per y	Jear (kgCD2 eq)

Figure 79. Awareness measures implemented in Stintino



3.2.2.3. Multicriteria Decision in Stintino

Considering the priorities established by the municipality, the criteria used to prioritize the different levels are as follows:

- Adapt the municipality's public facilities, including the allocation of necessary resources.
- Involve civil society to develop and improve the action plan with citizen awareness.
- Reduce energy consumption through actions in municipal buildings, public lighting, redevelopment, traffic reduction and promotion of sustainable mobility.
- Inclusion of photovoltaic systems in buildings and land in the municipality, as well as promoting their installation at the individual level.
- Development of heating with cogeneration plants.
- Assistance to local companies to create new job opportunities related to energy efficiency.

The assessments are introduced in the chosen software applying the AHP method and a final report is obtained, suitable for the municipality of Stintino.

Alternative Rankings

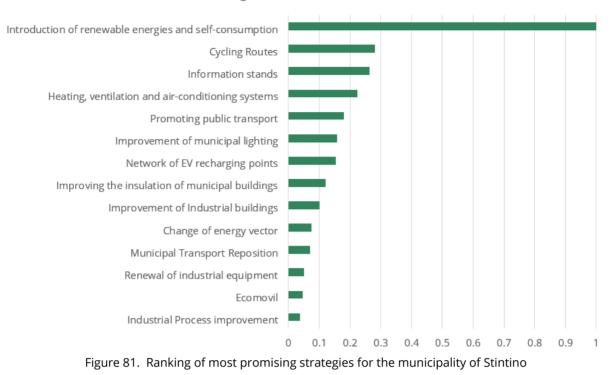
Graphic	Alternatives	Total	Normal	Ideal	Ranking
	CA1.1 Improving the insulation of municipal buildings	0.0146	0.0441	0.1219	8
	CA1.2 Improvement of municipal lighting	0.0190	0.0571	0.1578	6
	CA1.3 Heating, ventilation and air-conditioning systems	0.0268	0.0809	0.2234	4
	CA1.4 Introduction of renewable energies and self-consumption	0.1201	0.3622	1.0000	1
	CA1.5 Municipal Transport Reposition	0.0085	0.0257	0.0711	11
	CA2.1 Industrial Process improvement	0.0044	0.0134	0.0370	14
	CA2.2 Renewal of industrial equipment	0.0060	0.0182	0.0501	12
	CA2.3 Improvement of Industrial buildings	0.0121	0.0366	0.1010	9
	CA2.4 Change of energy vector	0.0091	0.0273	0.0755	10
	CA3.1 Cycling Routes	0.0337	0.1015	0.2803	2
	CA3.2 Network of EV recharging points	0.0185	0.0556	0.1536	7
	CA3.3 Promoting public transport	0.0215	0.0649	0.1790	5
	CA4.1 Ecomovil	0.0055	0.0167	0.0460	13
	CA4.2 Information stands	0.0317	0.0956	0.2640	3

Figure 80. Report on alternatives obtained for the municipality of Stintino

Finally, the ranking of the most valued alternatives taking into account the municipal casuistry is as follows:



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Ranking of measures in Stintino

3.2.2.4. Ranking of the most promising strategies in Stintino

In summary, the most promising strategies for the municipality of Stintino are presented. A table with the results obtained by implementing the GENERA tools is presented below:

PRIORITY	ACTION	ENERGY SAVINGS (MWh/year)	CO₂ SAVINGS (tCO₂e)	CATEGORY
1	Introduction of renewable energies and self-consumption	277.77	124.12	Municipal facilities
2	Cycling Routes	-	26.80	Transport
3	Information stands	36.47	43.91	Awareness
4	Heating, ventilation and air-conditioning systems	15.52	6.94	Municipal facilities
5	Promoting public transport	-	0.015	Transport
6	Improvement of municipal lighting	27.60	12.33	Municipal facilities
7	Network of EV recharging points	-	366.55	Transport
8	Improving the insulation of municipal buildings	1.45	0.65	Municipal facilities
9	Improvement of Industrial buildings	1279.30	571.85	Industry
10	Change of energy vector	-	-	Industry

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PRIORITY	ACTION		ENERGY SAVINGS (MWh/year)	CO ₂ SAVINGS (tCO ₂ e)	CATEGORY
11	Municipal Transport Reposition		-	1.15	Municipal facilities
12	Renewal of industrial equipment		-	-	Industry
13	Ecomovil		-	-	Awareness
14	Industrial Process improvement		-	-	Industry
		TOTAL	16019.74	1154.32	

Table 7. Most promising strategies in Stintino and estimated associated energy and emissions reductions

Stintino focuses mainly on municipal measures but also puts special effort into awareness-raising measures in the field of energy saving and even the promotion of public transport. Even so, the industrial field remains outside the scope of the action plan, except for the improvement of industrial buildings where measures are implemented.



3.3. Greece

Greece in particular is characterized by the highest per capita electricity consumption and the highest external energy dependence, with the highest percentage of fuel imports, more than double the average of the 45 countries (8.3%). Compared to the other countries analyzed, Greece consumes the most renewable energy, however, there is also a higher use of coal. One of the future approaches for this group of countries could be the progressive reduction of per capita electricity consumption to converge towards more sustainable values [8].

3.3.1. Study of the Greek National Context

Greece aims to reduce its greenhouse gas emissions by 58% by 2030 and to reach net zero emissions by 2050. In addition, it is developing renewable energies, which should cover 81% of its capacity in 2030. Through the use of module 1 of the GENERA tool, an analysis of Greece's energy context is made. The reference data are taken from the year 2023, which is the year for which complete information is available. The Greek energy mix for energy supply is mainly characterized by oil (53.6%), followed by natural gas (20.9%). Renewable energies such as geothermal, wind and wind, biofuels and coal are the next contributions respectively. CO_2 emissions in Greece have been reduced by 42% compared to 2000 data, making Greece an emitter of 0.15% of global emissions.

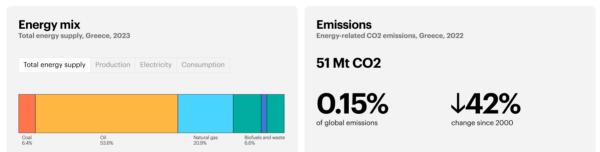


Figure 82. Summary of Greece's energy mix and emissions. Source: <u>https://www.iea.org/countries/greece</u>

Using Module 1 of the GENERA tools, 2022 reference data for Greece (as 2023 is incomplete for some sectors) are introduced and come from the International Energy Agency [1]. First, Figure 36 shows the contribution of each energy source in the main sectors of the economy. In Greece, there is a very high presence of oil in all sectors, although it stands out mainly in the transport sector, and others such as agriculture and fisheries. It is true that Greece requires maritime transport in most of its islands, so oil is necessary. Other sectors that also require oil are industrial, residential and electricity generation. The next most productive source is natural gas, which is most involved in electricity generation, followed by the industrial and residential sectors. Renewable energies are also producers of electricity and have a great impact on the residential sector. Finally, coal does not have a major impact in most sectors, except for electricity generation. It should be noted that there is no contribution from nuclear energy in Greece.



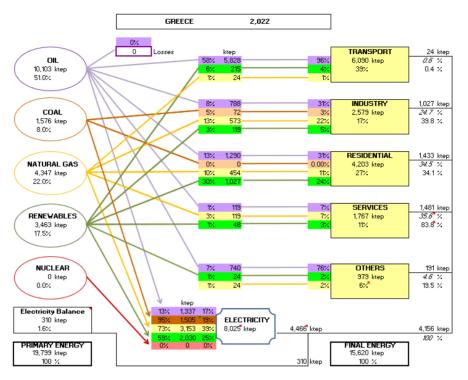


Figure 83. Energy balance of the different energy sources and sectors in Greece

After presenting an overview of the sources and sectors involved, the figures below show the evolution of the main indicators, such as primary energy demand, electricity generation and emissions up to 2030, following current trends.

First of all, the data on primary energy demand in the current Greek system show an increasing supply of oil. As discussed above, oil is the main source of energy, followed by natural gas. Therefore, Greece is heavily dependent on fossil fuels. However, renewable energies also have an increasing trend and are followed by natural gas. is very stable over the years, with the main share of natural gas and oil. In last place is coal, which has a very subtle growing tenure, so this could be reduced by implementing measures or encouraging the use of other types of energy.

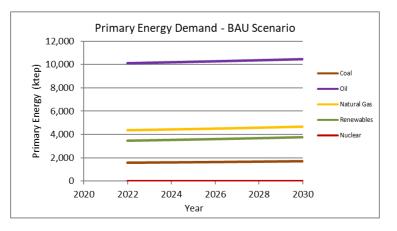


Figure 84. BAU Greece Scenario: Primary Energy Demand



Thereafter, electricity generation in Greece is mainly produced by Natural Gas, followed by renewable energies, coal and oil. All of them present an increasing trend. In addition, as mentioned above, there is no contribution from nuclear energy.

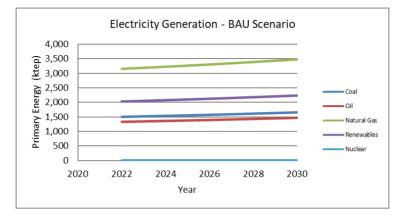


Figure 85. BAU Greece Scenario: Electricity Generation

Finally, Figure *86* shows the CO₂ emissions produced by each sector in Greece. The main CO₂ emitting sector is electricity generation, which may be due to the 19% contribution of coal (the sector in which coal is most involved), so implementing measures to reduce it is of vital importance. The transport sector continues with a lesser upward slope, which could be reduced by promoting public transport, low-emission zones, etc. The rest of the emissions are very evenly distributed among the residential, industrial and agriculture and fishing sectors. It should be noted that the industrial and agriculture and fishing sectors show a decreasing trend, so emissions are reduced.

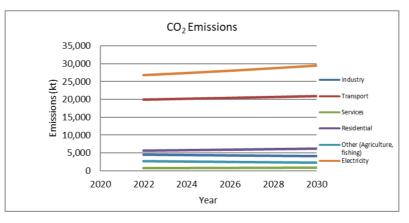


Figure 86. BAU Greece Scenario: CO₂ Emissions

The Greek energy context is mainly characterized by the use of oil and natural gas in sectors such as transportation and agriculture and fishing due to the country's economy. However, the sector that emits the most emissions is the electricity generation sector due mainly to coal. Renewable energies are more involved in the residential and electricity sectors. In addition, there is a growing trend in the use of renewable energies, mainly for electricity production. Natural gas also shows a growing trend and is among the main source of electricity generation. Finally, in terms of emissions, the most damaging sector



is electricity generation, followed by transportation. Creating and implementing measures that encourage the use of renewable energies for electricity generation and for the transportation sector could be a goal to reduce emissions in the coming years.

3.3.2. Pilot 4 in Halki

3.3.2.1. Features of Halki

Halki is the smallest inhabited island of the Dodecanese with an area of 28 km2. It is part of the regional unit of Rhodes. It has a permanent population of 330 inhabitants (increasing during the summer months), concentrated only in the village. The 2021 census showed a population of 475 inhabitants [9]. The Dodecanese climate is a transitional type from temperate to dry tropical climates and is characterized by intense sunshine and prolonged summer drought.

It has a large photovoltaic park and is expected to install solar energy installations, so thanks to the relatively low consumption of the island, it is estimated that the island's energy needs can be covered.

Section	Objective
Renewable energy	It has a large photovoltaic park and is expected to install solar energy installations, so thanks to the relatively low consumption of the island, it is estimated that the island's energy needs can be covered.
CO ₂ emissions	The municipality of Halki has set itself the target of reducing CO_2 by 105% by 2030, which exceeds the required 40% by far, so the emissions must be very demanding.

Table 8. Halki's main objectives in relation to energy sustainability

3.3.2.2. Summary of actions of Halki

The plan created for the Covenant of Mayors for Climate and Energy is studied for its creation and updating [10], and the measures are introduced in the GENERA tool for the evaluation of alternatives.

The main sectors in which the study is carried out are at the municipal, domestic and tertiary level, since industrial activity is almost nil in the municipality. At this stage, no measures are proposed for the introduction of renewable energies in municipal buildings, although the introduction of a solar energy park for solar energy production is proposed and will be considered in the tool.



G Municipal Buildings And Public Facilities

• Improving the building envelope

Halki's plan also includes a section on buildings, equipment and facilities that includes actions such as improving the building's thermal insulation, as well as replacing windows with double glazing. In this case the actions are more generalized so an estimate is made in the GENERA tool.

I			Improvi	ng the insulati	on of munici	al buildings		GREECE	
WINDOWS									
	Select Iro			1				Enter manual	Default valu
[1] Current windows		Frame improvem	ent]		[1] Transmittance	e (¥łm2K)		3.2
[2] New windows	Enter mai	Double glazing l	b Default v]		[2] Transmittance	e (¥/m2K)		1.8
Surface to be replaced (n		7.2	0.012						
		ng (k¥h/Year) ed per year (kgC	:O2 eq)			5417.073 3250.244	⊈ 0 2}		
INSULATION									
[1] Current Isolation	Select fro	n the list Insulating Brick]		[1] Material cond	uctivity (¥/m(Select from the list	Default valu 0.1
Is the insulation replaced or added to the existing insulation?	Replacen Added	en/ YES				[1] Insulation thic	kness (m)		0.01
[2] Insulation New		Expanded Polysty	ene]		[2] Material cond	luctivity (¥łm	Select from the list	0.08
Surface to be replaced (n Ceilings (m2) Valls (m2)	Enter man	<i>val</i> 200	Default v			[2] Insulation thic	ckness (m)		0.08
Usable surface									
Energy saving (k	₩h/Year)					855.37	C)D		
CO2 emissions s	aved per	year (kgCO2 eq)			513.222	2		1

Figure 87. Improving the envelope of public buildings in Halki

• Substitution Of Lights For More Efficient Ones

The replacement of lighting fixtures is also another priority action; it is proposed to replace the current ones with more efficient LEDs. Therefore, in this point there are two measures: the first one related to the improvement of interior lighting in public buildings and, on the other hand, the improvement of municipal public lighting, which is intended to be modified by low consumption LEDs.



and the second se	Imp	rovement of municipal lighting	
BUILDINGS	Select from the list	Enter manual	Default value
[1] Current Bulbs	Incandescentes	[1] Maz. Power (¥)	40
[2] New Bulbs	LEDs Enter manual	[2] Max. Power Entermanual Default value	9
Number of luminaires to be replaced	10	Hours of use (h) [SUMMER].	
STREETS			
	Select from the list	Enter manual	Default value
[1] Current Bulbs	Induction	[1] Maz. Potencia (V)	63
[2] New Bulbs	LEDs Enter manual	[2] Max. Potencia (W) Enter manual Default value	33
be replaced	25	Image: Note of the set of the s	
Energy saving (k	WhłYear)	4380.45	
CO2 emissions	saved per year (kgCO2 eq)	2628.270	

Figure 88. Lighting improvement measures at Halki

• Improvement of building conditioning

Improvements are proposed to the HVAC system, which currently consists of heat pump heating and cooling. The proposal is to improve the efficiency of the heat pump system, so a new one with better performance is proposed.

			Heating, ventilatio	n and air con	ditioning systems		GREECE
Current sy 3	ystem selecte		a single system, independent DH	v]		
Please e	enter your he HEAT	eating and cooling de FING	mand Enter manual		Default Value		
		demand (k¥hłyear) Irface to heat (m2)	0]	18000	
		mitter system	100		1		
	[3] System		Heat Pump		Default Value		
	[4] Energy la [5] Type of e		B Select Air Conditioning] 4		
	[5.1] Type of		Fan Coils]		
	[5.1] System [6] SCOP		dividual split type equipment (ind	ividual and bloc]	3.4	
	[7] Coolant	used	Other]		
COOLIN	NG						
[1] Curi	rent cooling d	<i>Enter man</i> emand (k∀hł	ul	Default Value	900		
[2] Use Select the cooli	ful surface to		90]			
				_		[4] Fan	No
	nergy label ype of equipm	ent	B Air Conditioning]		[4.1] Type of fan [4.2] Energy consumption p	Ceiling Default Value er hour 0.5
	ype of equipm		Fan Coils]		[4.3] Hours of use per year	Default Value 900 hiyea
[3.4] SI	EER			5.1	,	[4.4] Number of fans	0
[3.5] C	oolant used		Other]			
[3.6] C	ooling Consu	mption k\#h/Year)	376.18]		[4.5] Total energy consum	otion of fans 0 kWhlyear
	Cooling Co	nsumption (k¥h/Year)			891	5.07	
	CO2 Emissi	ons (gCO2 eq)			5349.044	1988	

Figure 89. Consumption of the current heat pump system in Halki buildings



THEATING						
Select the heating emitter system						
[3] System	Heat Pump					
[4] Energy label	Hect A++	Default Value A				
[5] Type of equipment	viect Air Conditioning					
[5.1] Type of equipment	Fan Coils					
[5.1] System div	idual split type equipment (individual and bloc					
[6] SCOP			5.1			
*						
COOLING						
Select the cooling emitter system						
beloet the cooling entitle bystern						
				[4] ¥entilador	No	
[3.1] Energy label	A++			[4.1] Type of fan	Ceiling	Default Value
[3.2] Type of equipment	Air Conditioning			[4.2] Energy consumption per hour		0.5
[3.3] Type of equipment	Fan Coils			[4.3] Hours of use per year		Default Value 900 hiyear
[3.4] SEER		8.5		[4.4] Number of fans	0	
[3.5] Coolant used	Other					
[3.6] Cooling Consumption (kWhłYe	ar) 224.58			[4.5] Total energy consumption of fans	0	kWh/year
Energy Consumption(kWh/)	'ear]		5917.1	18		

Figure 90. Renovation of the AACC system for municipalities in Halki

In summary, the energy saved and emissions mitigated by changing the air conditioning system is presented in the following figure:

Heating, ventilation and air conditio	ning systems
Select the option that best suits your current system : 3 Heating and cooling in a single system, independent DHW	
Click on the number that corresponds to the chosen option:	34
Energy Consumption k¥h/Year)	8315.07
CO2 Emissions (gCO2 eq)	5349.045
NEW S	SYSTEM
Please select the type of system to be used 3 Heating and cooling in a single system, independent DHW	
	34
Heating and cooling in a single system, independent DHW Click on the number that corresponds to the chosen	3 4
3 Heating and cooling in a single system, independent DHW Click on the number that corresponds to the ohosen option:	34
3 Heating and cooling in a single system, independent DHW Click on the number that corresponds to the chosen option: 1 2 Energy Consumption (kVh/Year)	3 4

Figure 91. Summary of energy saved and emissions mitigated by the change of air conditioning in municipal buildings at Halki



• Introduction of photovoltaic solar energy for power production

Instead of proposing measures at the municipal level, it is proposed to introduce solar energy in a photovoltaic park with the idea of contributing to an energy community.

PHOTOVOLTAIC	Solar	Energy System?	YES Batteries for storage? ND
PHOTO¥OLTAIC			Surplus compensation
Building energy consumption		21900	
Types of solar collector	Monocrystalline	Performance (%)	Default Value Default Value 0.23 Collector size (₩) 100 200
Power generated (kWh)	19282.89525]	Number of collectors 3 1
Battery capacity (Ah)] 0	
Stored Energy (k¥h)]	
Energy savings (kVh/Year)			2617.10
CO2 emissions saved per year (kg	:O2 eq)		1570.263

Figure 92. Photovoltaic solar energy in the municipality of Halki

• Renewal of municipal fleet of energy efficient vehicles

The municipality of Halki has replaced some vehicles in the municipal fleet with electric vehicles: 4 to cover municipal services and 2 more vehicles delivered to the police department.

Number of vehicles withdrawn	6	 Default Value		
Average travel distance per vehicle per gear		16.5	CO2 emissions per vehicle per country (kgCO2/year)	541
		Default Value		
Electricity consumption of a E¥		0.2		
No. of new electric vehicles	6		CO2 emissions per vehicle per country (kgCO2/gear)	2
Energy savings (k¥h/Year)				

Figure 93. Emission reductions by replacing conventional vehicles with electric vehicles at Halki



G Transport

Transport measures are other measures that may be of interest to the municipality to reduce its carbon footprint.

• Cycling Routes

A measure would be the introduction of cycling routes that encourage cycling and reduce the use of conventional vehicles.

ର୍ତ୍ତ	Cycling Routes			GREECE
	Inhabitai	nts		
[1] Number of inhabitants in the municipality	475]		
	km			
[2] Distance of built-up cycleway	10]		
		1		
[3] gCO2 emissions generated	1170.875	J		
[4] gCO2 emissions saved	5791547.561]		
Energy saving (kWh	/Year)		0.000	
CO2 emissions save	d per year (kgCO2 eq)		5790376.686	- 2 2

Figure 94. Creation of bike lanes in Halki

• Promoting public transport

The main measures introduced in relation to public transport are the improvement of the transport schedule and frequency, as well as the promotion of special fares for young people.

		Promotin	g public transport				
\checkmark	Please select the measu	lease select the measures applied in the promotion of public transport:					
	Share CO2 savings	Apply	Emissions saved by municipality (kg of carbon dioxide)				
Reduced Speed Zones	25%		0.00				
Increase in the frequency of PT passage	10%	x	0.09				
Reducing fees for Youth and Pensioners	5%	x	0.05				
Ecozone (ZBE)	97%		0.00				
Tolls (depending on rush hour or not)	30%		0.00				
Congestion charging (reducing the number of cars entering the city	20%		0.00				
		TOTAL	0.14				
Ahorro en	nergético (kWh/Año)						
Emisione	es CO2 ahorrada al año (kg	CO2 eq)					

Figure 95. Measures to promote the use of public transport in Halki





G Awareness

• Implementation of Ecomovil

The option of introducing an ecomovil to promote recycling and waste management is being considered.

<u> </u>	Ecomovil			LOCATION GREECE
[1] Number of inhabitants in the municipali	inhabitan 475	 's		Does it apply? YES
[2] Increase in the Municipal Collection Vaste (MSV) collection rate (%)	km	10%	Default Value	
[3] Hours of service (days per year)	4			
[4] Recycled renewable fraction (kg)	60.758			
Energy saving (k	¥h/Year)		52.697	- G
CO2 emissions s	aved per year (kgCO2 eq)		31.618	_ 🏠

Figure 96. Recycling awareness action in Halki

• Citizen promotion and awareness

It is also proposed to work hard to raise public awareness. A communication and awareness-raising plan is proposed, including days for young people, training workshops, responsible consumption strategies for housing and tertiary sectors.

		Information stands
~	Select the action	ons you plan to implement in your municipality
		Арріу
1	Communication, training and a v areness-raising plan	×
2	Environmental school for school groups	x
3	Collection of special vaste at Clean Points (recycling centres)	
4	Bonuses for self-consumption:	
	IBI (property and real estate tax)	
	ICIO (Construction and works tax)	
	IAE (Business Activity Tax)	
	Municipal Fees	
5	Responsible energy consumption strategies	×
	Energy saving (k¥h/Year)	
	CO2 emissions saved per	1 gear (kgCO2 eg

Figure 97. Sensitization actions for citizenship at the municipal level in Halki



3.3.2.3. Multicriteria Decision in Halki

Considering the priorities established by the municipality, priority actions are identified as follows:

- Promotion of recycling and organics reduction.
- Energy audit in municipal buildings.
- Information to users to improve the behaviour and optimal use of the different equipment.
- Substitution of LED lamps in lighting systems.
- Development of heating with cogeneration plants.
- Assistance to local companies to create new job opportunities related to energy efficiency.

The assessments are introduced in the chosen software applying the AHP method and a final report is obtained, suitable for the municipality of the municipality of Halki.

Alternative Rankings

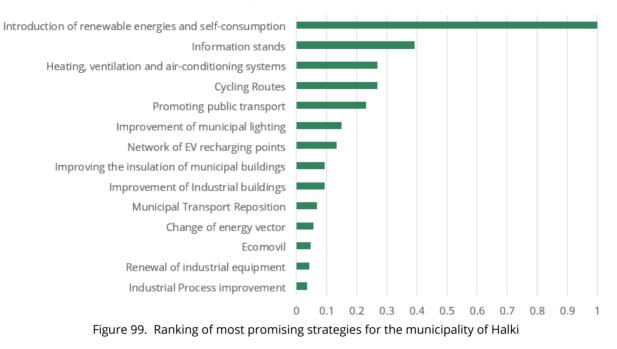
Graphic	Alternatives	Total	Normal	Ideal	Ranking
	CA1.1 Improving the insulation of municipal buildings	0.0108	0.0327	0.0940	8
	CA1.2 Improvement of municipal lighting	0.0172	0.0520	0.1494	6
	CA1.3 Heating, ventilation and air-conditioning systems	0.0310	0.0936	0.2690	3
	CA1.4 Introduction of renewable energies and self-consumption	0.1154	0.3479	1.0000	1
	CA1.5 Municipal Transport Reposition	0.0078	0.0234	0.0674	10
	CA2.1 Industrial Process improvement	0.0040	0.0119	0.0343	14
	CA2.2 Renewal of industrial equipment	0.0048	0.0143	0.0412	13
	CA2.3 Improvement of Industrial buildings	0.0107	0.0323	0.0928	9
	CA2.4 Change of energy vector	0.0064	0.0192	0.0552	11
	CA3.1 Cycling Routes	0.0310	0.0935	0.2688	4
	CA3.2 Network of EV recharging points	0.0154	0.0464	0.1334	7
	CA3.3 Promoting public transport	0.0266	0.0801	0.2301	5
	CA4.1 Ecomovil	0.0053	0.0160	0.0461	12
	CA4.2 Information stands	0.0453	0.1366	0.3928	2

Figure 98. Report on alternatives obtained for the municipality of Halki

Finally, the ranking of the most valued alternatives taking into account the municipal casuistry is as follows:



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Ranking of measures in Halki

3.3.2.4. Ranking of the most promising strategies in Halki

In summary, the most promising strategies for the municipality of Halki are presented. A table with the results obtained by implementing the GENERA tools is presented below:

PRIORITY	ACTION	ENERGY SAVINGS (MWh/year)	CO ₂ SAVINGS (tCO ₂ e)	CATEGORY
1	Introduction of renewable energies and self-consumption	2.62	1.57	Municipal facilities
2	Information stands	0.33	0.68	Awareness
3	Heating, ventilation and air-conditioning systems	3.00	1.80	Municipal facilities
4	Cycling Routes	-	5.79	Transport
5	Promoting public transport	-	0.06	Transport
6	Improvement of municipal lighting	4.38	2.63	Municipal facilities
7	Network of EV recharging points	-	-	Transport
8	Improving the insulation of municipal buildings	6.27	3.76	Municipal facilities
9	Improvement of Industrial buildings	-	-	Industry

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PRIORITY	ACTION		ENERGY SAVINGS (MWh/year)	CO ₂ SAVINGS (tCO ₂ e)	CATEGORY
10	Municipal Transport Reposition		-	-	Industry
11	Change of energy vector		-	1.15	Municipal facilities
12	Ecomovil		0.053	0.031	Industry
13	Renewal of industrial equipment		-	-	Awareness
14	Industrial Process improvement		-	-	Industry
		TOTAL	16.65	17.47	

Table 9. Most promising strategies in Halki and estimated associated energy and emissions reductions

Halki is a very small municipality, so the reduction of energy and emissions is proportional to the number of inhabitants, although it is true that tourism modifies this number. As for the measures, the focus is on the municipal level and on raising public awareness, both in terms of sensitivity and the promotion of transportation.

3.3.3. Pilot 5 in Rhodes

3.3.3.1. Features of Rhodes

Rhodes is the largest of the Dodecanese islands, between the Aegean Sea and the coast of the Middle East. The municipality, also called Rhodes consists of 56,000 inhabitants [9]. In terms of climate, Rhodes is characterized by a warm Mediterranean climate in summer, with dry summers and mild, wet winters.

The main productive sector is the tertiary sector, while the primary sector is essential to the local economy. The primary sector includes mainly olive growing, viticulture, livestock, beekeeping, fishing and aquaculture. On the other hand, the tertiary sector is characterized by commerce, tourism, public and private services mainly.

The main problem of the municipality of Rhodes is the remarkable demographic growth, which is closely related to the constantly increasing tourist activity. This will mean a greater demand for energy and, therefore, a larger emissions footprint that must be mitigated with sustainability measures.

The Rhodes Municipality signed the Covenant of Mayors and committed itself to local action in the direction of sustainability in line with the objectives set by the EU by 2030:

Section

Objective



CO₂ emissions

Increase secure energy supply and reduce reliance on imported amounts of energy to reduce the island's energy footprint and greenhouse gas emissions by 40.18% from 2015 levels.

Table 10. Sustainable objectives to be achieved by the municipality of Rhodes

3.3.3.2. Summary of actions of Rhodes

The goals and objectives of the municipality of Rodes can be grouped into the following groups according to the information gathered from its action plan [11]: improvement of building efficiency, electrification of transport, energy improvement of public lighting, energy improvement of water supply and irrigation infrastructures and renewable energy sources to meet the needs of demand.

G Municipal Buildings And Public Facilities

Rhodes proposes a large number of energy saving and efficiency measures, but directly aimed at consumers and citizens, for example: reduction of DHW demand with saving measures, improvement of heating and/or cooling measures with interventions in the building, etc. However, the GENERA tool will be used to introduce these measures, although they are not applied at the municipal level but rather at the local level.

• Improving the building envelope

One of the measures proposed is to increase energy efficiency in construction by replacing old systems, which is why it is proposed to introduce better insulation and windows.

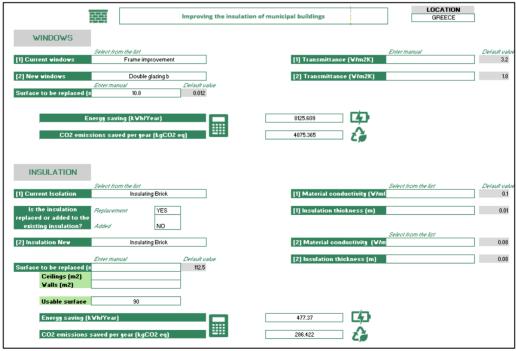


Figure 100. Construction efficiency measures in Rhodes.

• Indoor lighting renovation



The aim is to reduce lighting energy demand through the use of more efficient lighting systems, in addition to other awareness-raising measures.

ι. U		provement of municipal lighting]	
BUILDINGS				
[1] Current Bulbs	Select from the list Incandescentes	[1] Maz. Power (¥)	Enter manual	<i>Default var</i> 40
[2] New Bulbs	LEDs	[2] Maz. Power		9
Number of luminaires to be replaced	Enter manual 50	Hours of use (h) [SUMMER].	Entermanual Default value 7.5	
STREETS				
[1] Current Bulbs	Select from the list Induction	[1] Max. Potencia (¥)	Enter manual	<i>Default va</i> 63
[2] New Bulbs	LEDs Enter manual	[2] Max. Potencia (W)	Enter manual Default value	33
be replaced	0	Hours of use (h) [SUMMER].		
Energy saving (k CO2 emissions s	∀hłYear) saved per year (kgCO2 eq)	302.25 LA 191.350 A		

Figure 101. Improvement of lighting fixtures in buildings in Rhodes

• Improvement of building conditioning

Improving energy efficiency through the use of Class A inverter air conditioning systems is another measure being promoted at Rhodes.

	Heating, ventilation and air	conditioning systems			GREECE	
Current system selected 3 Heating and coo Please enter your heating and coo	oling in a single system, independent DHW					
HEATING	Enter manual	Default Value	10800			
[2] Useful surface to heat						
Select the heating emitter system						
[3] System	Heat Pump Select	Elefault Value				
[4] Energy label	B Select	A				
[5] Type of equipment	Air Conditioning					
[5.1] Type of equipment	Fan Coils					
[5.1] System	dividual split type equipment (individual an	d blog				
[6] SCOP			3.4			
[7] Coolant used	Other					
COOLING [1] Current cooling demand (k [2] Useful surface to cool (m2	Enter manual		20			
CODLING [1] Current cooling demand (k	Enter manual			Esa		No
COOLING (1) Current cooling demand (k (2) Useful surface to cool (m2 islest the cooling emilter system	Enter manual and 2) 30		[1	Fan		No
(1) Current cooling demand (k (2) Useful surface to cool (m islett the cooling emilter system (3.1) Energy label	Eller manual 2) 90 8		1	1] Type of fan	ation not bour	Ceiling Default Value
(1) Gurrent cooling demand (k (2) Useful surface to cool (m isletet the cooling emilter system (3.1) Energy labet (3.2) Type of equipment	Eller manual 23 30 B Air Conditioning		به ان ان	1] Type of fan 2] Energy consump		Ceiling Default Yahu 0.5 Default Yahu
(1) Current cooling demand (k [2] Useful surface to cool (m2 islect the cooling emilter system [3.1] Energy label [3.2] Type of equipment [3.3] Type of equipment	Eller manual 2) 90 8		ت ت ت ت	1] Type of fan 2] Energy consump 3] Hours of use pe	er year	Ceiling Default Value 0.5 Default Value \$00 hly
(1) Current cooling demand (k [2] Useful surface to cool (m2 [2] Useful surface to cool (m2 [3] I) Energy label [32] Type of equipment [3.3] Type of equipment [3.4] SEER	2) 90 Beer manual 2) 90 B Air Conditioning Fan Colls		ت ت ت ت	1] Type of fan 2] Energy consump	er year	Ceiling Default Yahu 0.5 Default Yahu
(1) Current cooling demand (k (2) Useful surface to cool (m2) (3.1) Energy label (3.2) Type of equipment (3.3) Type of equipment (3.4) SEER (3.5) Coolant used	Eller manual 2) 90 B Air Conditioning Fan Cols Dither		ی ی ی ی ی	1] Type of fan 2] Energy consump 3] Hours of use po 4] Number of fans	er gear	Ceiling Default Value O.5 Default Value 300 hly
(1) Current cooling demand (k [2] Useful surface to cool (m2 [2] Useful surface to cool (m2 [3] I) Energy label [32] Type of equipment [3.3] Type of equipment [3.4] SEER	Eller manual 2) 90 B Air Conditioning Fan Cols Dither		ی ی ی ی ی	1] Type of fan 2] Energy consump 3] Hours of use po 4] Number of fans	er year	Ceiling Default Value 0.5 Default Value \$00 hly
(1) Current cooling demand (k (2) Useful surface to cool (m2) (3.1) Energy label (3.2) Type of equipment (3.3) Type of equipment (3.4) SEER (3.5) Coolant used	Eller manual 2) 90 B Air Conditioning Fan Cols Dither		ی ی ی ی ی	1] Type of fan 2] Energy consump 3] Hours of use po 4] Number of fans	er gear	Ceiling <i>Derioult Value</i> 0.5 <i>Derioult Value</i> 300 h/y 0
(1) Current cooling demand (k (2) Useful surface to cool (m2) (3.1) Energy label (3.2) Type of equipment (3.3) Type of equipment (3.4) SEER (3.5) Coolant used	Eliver manual 2) 90 B Air Conditioning Fan Cols Other Vh/Year) 376.18		ی ی ی ی ی	1] Type of fan 2] Energy consump 3] Hours of use po 4] Number of fans	er gear	Ceiling Default Yaka Official Yaka Soo hit

Figure 102. Current air conditioning system in Rhodes



* HEATING					
Select the heating emitter system					
[3] System	Heat Pump	1			
[4] Energy label	Select	Default Value			
	Select				
[5] Type of equipment	Air Conditioning				
[5.1] Type of equipment	Fan Coils]			
[5.1] System	dividual split type equipment (individual and bloc	1			
[6] SCOP]	4		
COOLING					
Select the cooling emitter system					
Select the cooling entitler system					
			[4] Ventilado	or No	
[3.1] Energy label	A]	[4.1] Type of	fan Ceilin	
[3.2] Type of equipment	Air Conditioning]	[4.2] Energy	consumption per hour	Default Value 0.5
[3.3] Type of equipment	Fan Coils]	[4.3] Hours	of use per year	<i>Default Value</i> 900 hlyea
[3.4] SEER		5.6	[4.4] Numbe	er of fans O	
[3.5] Coolant used	Other]			
[3.6] Cooling Consumption (k)	Wh/Year) 342.21]	[4.5] Total	energy consumption of fans	kWh/year
Energy Consumption(k₩hłYear)		4697.04		
CO2 Emissions (qCO2	2 eq)		2818.22642		

Figure 103. Improved air conditioning system in Rhodes

Improving the system with the aforementioned equipment results in a reduction of energy consumption and emissions as shown in the following figure:

0				
	ing, ventilation and air conditio	ning systems		
Select the option that best suits your current syste				
3 Heating and cooling in a single system, ind	ependent DHW			
Click on the number that corresponds to the chosen option:	02	3 4		
Energy Consumption kWh/Yea	ar)		5499.52	
CO2 Emissions (gCO2 eq)			3299.709	
	NEWS	SYSTEM		
Please calest the type of system to be used				
Please select the type of system to be used	sustem independent NHW			
3 Heating and cooling in a single	system, independent DHW			
	system, independent DHW	8		
3 Heating and cooling in a single Click on the number that corresponds to the chosen	12	3	4697.04	
3 Heating and cooling in a single Click on the number that corresponds to the chosen option:	12	3	4697.04 2818.228	
3 Heating and cooling in a single Click on the number that corresponds to the chosen option: Energy Consumption (kVh/Ye	12	802.47		

Figure 104. Energy savings and emissions mitigation by changing the air conditioning in Rhodes

• Introduction of renewable energies in public buildings

Reducing the annual rate of DHW energy demand through the use of solar thermal energy by 2030 is another of the municipality's priorities, but the use of this technology is encouraged at the individual level. However, it is also proposed for public buildings such as schools and other types, so the latter option is considered in the tool.



*		Introduction of	renewable energies	and self-c	onsumption				
DATA									
	Select from the list				_				
[1] Type of building	Publ	lic Buildings	No. of workers	15	U	nit consump	tion of DH¥ (I/day)		30
[2] Usable surface		100]						
			Default value						
[3] Hours of use			7.5						
[4] Annual electrical demand of the building (k∀h)			2737.5						
SOLAR THERMAL		Solar ⁻	Thermal Energy?	YES					
Daily consumptio	n (m3/s)		0.000006		Useful sur	face (m2)	10	1	
DH¥ demand (K¥	'h/year)		922.6						
Storage tank (L)		25		,	Tefault value		Default value		
Type of solar coll	ector	Flat Collector	Performance(%)			tor area	1.5 2		
24									
Generated power	(k¥)/Collector	0.78	Total Power Gener	ated (k∀)	0	.78	J		
Total Energy Gen	erated	1422.15]						
Energy savings (k	Wh/Year)			1	1422.15	ZD			
CO2 emissions sa	aved per year (I	kgCO2 eq)	===	8	53.289	Éğ			1

Figure 105. Implementation of solar thermal energy in buildings in Rhodes

It is also proposed to use agricultural waste biomass for electricity production, thus reducing energy costs and mitigating emissions.

Kg of waste per dag	75				Types of organic waste	Kg
					Animal origin	
Percentage of organic waste (%)			50%		Plant origin	50
					Human origin	
Organic mass (kg per day)	38				Agro-industrial	
					Forestry	25
Yolume of Methane generated (CH4)	10				Aquatic Crops	
Reactor recovery efficiency (%)]	60%			
Yolume of methane available	6					
Energy generated (k¥h/day)	2					
Energy savings (kWh/Year)				894.47		

Figure 106. Use of biomass for energy use in Rhodes

Replacement of conventional municipal vehicles •

Replacing municipal vehicles with more efficient ones, such as electric vehicles, is another of the measures to be considered within the municipality. In this case, it is proposed to replace 3 vehicles by EV.



Number of vehicles withdrawn	3	 Default Value		
Average travel distance per vehicle per gear		16.5	CO2 emissions per vehicle per country (kgCO2/gear)	541
		Default Value		
Electricity consumption of a E¥		0.2		
		_		
No. of new electric vehicles	3		CO2 emissions per vehicle per country (kgCO2/year)	2

Figure 107. Replacement of conventional municipal vehicles in Rhodes

G Industry

In the industrial field, measures are proposed for energy saving by consumers through the replacement of systems with more efficient ones.

								LOCATION
\checkmark	Please select the in	lustry line in wh	ich the measures	apply:				GREECE
Incentive lines	š= 🔽							
Change of energy vector								
Industrial buildings								
Process improvement								
Renewal of equipment								
	Please select below the act	ons that you cor	isider of interest t	o implement:				
Incentive lines	T Actions -	Energy savings () 🎽	Electric energy savings	Ratio (investment/savin: ┸	Emissions tCo2/year			
ene v al of equipment	Replacement of existing chiller plant for one with natural refrigerant R717 (ammonia)	40%	348900.00	1133.27601	184.78			
ene v al of equipment	Replacement of existing refrigeration plant with partial heat recovery refrigeration plant	60%	104670.00	327.3430782	53.32			
ene v al of equipment	Replacement of existing chiller plant for one with natural refrigerant R290 (propane)	60%	3605300.00	0.343938091	22.81			
ene v al of equipment	Industrial air conditioning with EC fans (electronic switching)	40%	46520.00	44193.55116	24.75			
		Energy saving	(k\hlYear)			4	105390.000	
		CO2 emissions	saved per year (k	gCO2 eq)			463234.000	

Figure 108. Rhodes industrial equipment refurbishment improvement measures

G Transport

• Construction of cycling lanes

Rhodes has planned several important transportation measures, including the creation of bike lanes. Therefore, taking into account the inhabitants of the municipality and the distance, a 10 km bike path is proposed.



ର୍ତ୍ତ	Cycling Routes			LOCATION GREECE
	Inhabita	nts		
[1] Number of inhabitants in the municipality	50000			
	km			
[2] Distance of built-up cycleway	10			
		_		
[3] gCO2 emissions generated	123250			
[4] gCO2 emissions saved	609636585.366	1		
[4] geoz emissions saved	009030383.300			
Energy saving (kWł	n/Year)		0.000	
CO2 emissions save	ed per year (kgCO2 eq)		609513335.366	

Figure 109. Creation of bike lanes in Rhodes

• Charging points for hybrid or electric vehicles

The use of electric vehicles and the implementation of charging points is another measure that promotes the reduction of emissions at the municipal level. This measure is in line with the replacement of EVs at the municipal level. Due to the size of the municipality, it is proposed to introduce 2 EV charging points.

	Network of EV rech	narging points
[1] Number of chargers installed	2	
		Standard charger
[2] Charger power (kW)		20
[3] Power supplied by charger (kWh)	29200	
Sjrower supplied by charger (kwn)	29200	
[4] Electric vehicle consumption (passenger cars) (kWh/km)	0.200	
		Default Value
[5] Cars supplied		10
		Default Value
[6] allowable km		146000
Energy saving (kV		
CO2 emissions sa	wed per year (kgCO2 eq)	724160.000

Figure 110. Creation of EV recharging points in Rhodes

• Promotion of public transport

The last measure is the promotion of public transport among the citizens, mainly by increasing the frequency of public transport and the reduction of fees for young people and pensioners.



\checkmark	Please select the measu	ures appli	ed in the promotion of pu
	Share CO2 savings	Apply	Emissions saved by municipality (kg of carbon dioxide)
Reduced Speed Zones	25%		0.00
Increase in the frequency of PT passage	10%	x	0.09
Reducing fees for Youth and Pensioners	5%	x	0.05
Ecozone (ZBE)	97%		0.00
Tolls (depending on rush hour or not)	30%		0.00
Congestion charging (reducing the number of cars entering the city	20%		0.00
		TOTAL	0.14

Figure 111. Promotion of public transport in Rhodes

G Awareness

A large number of energy saving and consumption reduction measures are proposed for citizens.

• Citizen promotion and awareness

Many measures proposed in Rhodes are aimed at citizens with the idea of promoting energy saving measures and introducing new, more efficient systems.

	in the second se	Information stands
\checkmark	Select the act	tions you plan to implement in your municipality
		Аррју
1	Communication, training and a v areness-raising plan	×
2	Environmental school for school groups	×
3	Collection of special vaste at Clean Points (recycling centres)	
4	Bonuses for self-consumption:	L
	IBI (property and real estate tax)	J
	ICIO (Construction and works tax)	
	IAE (Business Activity Tax)	a
	Municipal Fees	s
5	Responsible energy consumption strategies	×
	Energy saving (k¥h/Year	
	CO2 emissions saved pe	er gear (kgCO2 eq

Figure 112. Public awareness measures in Rhodes



3.3.3.3. Multicriteria Decision in Rhodes

Considering the priorities established by the municipality, the criteria used to prioritize the different levels are as follows:

- At the municipal level, energy saving and efficiency measures are implemented.
- Electricity production from renewable sources is a priority, to minimize fossil fuels and encourage local generation.
- In the tertiary sector, equipment renovation is also promoted.

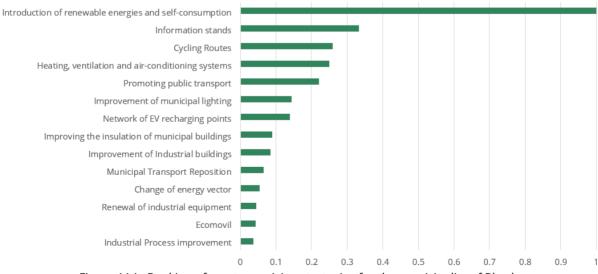
The assessments are introduced in the chosen software applying the AHP method and a final report is obtained, suitable for the municipality of Rhodes.

Graphic	Alternatives	Total	Normal	Ideal	Ranking
	CA1.1 Improving the insulation of municipal buildings	0.0107	0.0323	0.0893	8
	CA1.2 Improvement of municipal lighting	0.0172	0.0519	0.1434	6
	CA1.3 Heating, ventilation and air-conditioning systems	0.0300	0.0903	0.2498	4
	CA1.4 Introduction of renewable energies and self-consumption	0.1199	0.3616	1.0000	1
	CA1.5 Municipal Transport Reposition	0.0078	0.0234	0.0648	10
	CA2.1 Industrial Process improvement	0.0045	0.0134	0.0371	14
	CA2.2 Renewal of industrial equipment	0.0054	0.0163	0.0450	12
	CA2.3 Improvement of Industrial buildings	0.0103	0.0309	0.0855	9
	CA2.4 Change of energy vector	0.0065	0.0195	0.0539	11
	CA3.1 Cycling Routes	0.0311	0.0937	0.2591	3
	CA3.2 Network of EV recharging points	0.0167	0.0503	0.1391	7
	CA3.3 Promoting public transport	0.0266	0.0801	0.2214	5
	CA4.1 Ecomovil	0.0052	0.0156	0.0430	13
	CA4.2 Information stands	0.0400	0.1207	0.3338	2

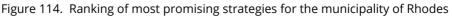
Alternative Rankings

Figure 113. Report on alternatives obtained for the municipality of Rhodes

Finally, the ranking of the most valued alternatives taking into account the municipal casuistry is as follows:



Ranking of measures in Rhodes





3.3.3.4. Ranking of the most promising strategies in Rhodes

In summary, the most promising strategies for the municipality of Rhodes are presented. A table with the results obtained by implementing the GENERA tools is presented below:

PRIORITY	ACTION	ENERGY SAVINGS (MWh/year)	CO₂ SAVINGS (tCO₂e)	CATEGORY
1	Introduction of renewable energies and self-consumption	2.32	1.39	Municipal facilities
2	Information stands	73.35	94.34	Awareness
3	Cycling Routes	-	609.51	Transport
4	Heating, ventilation and air-conditioning systems	0.80	0.48	Municipal facilities
5	Promoting public transport	-	6.75	Transport
6	Improvement of municipal lighting	0.30	0.18	Municipal facilities
7	Network of EV recharging points	-	724.16	Transport
8	Improving the insulation of municipal buildings	1.45	0.65	Municipal facilities
9	Improvement of Industrial buildings	8.60	5.16	Industry
10	Municipal Transport Reposition	-	1.61	Transport
11	Change of energy vector	-	-	Industry
12	Renewal of industrial equipment	4105.39	2463.23	Industry
13	Ecomovil	-	-	Awareness
14	Industrial Process improvement	-	-	Industry
	TOTAL	4192.21	3907.46	

Table 11. Most promising strategies in Rhodes and estimated associated energy and emissions reductions

The most promising strategies for Rhodes focus primarily on improving municipal facilities, public awareness and transportation. In addition, although not among their priorities, they also see the need for changes in industrial equipment to support the renovation of the tertiary sector and the reduction of municipal energy consumption.

3.3.4. Pilot 5 in Nisyros

3.3.4.1. Features of Nisyros

Nisyros is located in the southeastern Aegean Sea right in the center of the Dodecanese. It has a total area of 50,055 km2 and a total population of 1,048 inhabitants (2021) [9]. Nisyros has one of the largest geothermal deposits in Greece (second only to Milos), with an electricity generation potential of several tens of MW. The high amounts of (thermal)



energy that can be extracted from shallow wells can cover the heating or energy supply needs of farms. Among the main objectives of the municipality to achieve in its plan through the actions highlights:

Section	Objective
Renewable Energy	Increasing the share of renewable energies in the energy balance and, above all, exploiting the island's remarkable geothermal field.
CO ₂ emissions	The City Council aims for a 100% reduction in local emissions.
Energy Efficiency	To reduce the economic consumption of energy in urban infrastructure and municipal lighting, by improving the energy efficiency of the equipment.
Energy Savings	Reduce energy consumption in the construction sector, with the promotion of energy saving actions in hotels and municipal buildings and with actions to inform residents, as regards the domestic sector.

Table 12. Objectives of the energy plan for the municipality of Nisyros

3.3.4.2. Summary of actions of Nisyros

Among the main actions that have been observed in its plan [12] are the categories of municipal equipment and infrastructure, along with lighting, transportation and awareness-raising measures.

G Municipal Buildings And Public Facilities

• Renewal of lighting fixtures

Nisyros proposes lighting improvement measures at the municipal level. Therefore, the changeover to LED luminaires for both indoor and outdoor street lighting is proposed.

Ę	5	Improvement of municipal lighting	
BUILDINGS			
	Select from the list	Enter manual	Elefault valu
[1] Current Bulbs	Incandescentes	[1] Max. Power (∀)	40
[2] New Bulbs	LEDs	[2] Maz. Power	9
Number of luminaires to I	Enter manual	Enter manual Default value	
be replaced	25	Hours of use (h) [SUMMER]. 7.5	
STREETS	Select from the list	Foter manual	Fiefault vali
	Select from the list Induction	[1] Maz. Potencia (V)	Default vah 63
1] Current Bulbs		[1] Max. Potencia (¥) [2] Max. Potencia (W)	
1] Current Bulbs 2] New Bulbs	Induction LEDs Enter manual	[1] Max. Potencia (V) [2] Max. Potencia (W) [2] Max. Potencia (W) [2] Entermanual Default value	63
STREETS 1] Current Bulbs 2] Nev Bulbs be replaced	Induction LEDs	[1] Maz. Potencia (V) [2] Max. Potencia (W) Enter manual Elefault value Image: State of the state o	
1] Current Bulbs 2] Ne v Bulbs	Induction LEDs Enter manual	[1] Max. Potencia (V) [2] Max. Potencia (W) [2] Max. Potencia (W) [2] Entermanual Default value	63
1] Current Bulbs 2] New Bulbs	Induction LEDs Enter manual 50	[1] Maz. Potencia (V) [2] Max. Potencia (W) Enter manual Elefault value Image: State of the state o	63

Figure 115. Installation of more efficient luminaires in Nisyros



• Improvement of building conditioning

Air conditioning on the Greek islands is necessary, mainly in summer. Nisyros is committed to the use of geothermal energy for local power generation and also for use in air conditioning. Therefore, it is proposed to switch from heat pumps with lower energy labelling to the use of geothermal energy for heating, cooling and DHW.

On the one hand, the data of the previous system are entered into the tool, considering a heat pump for heating and cooling, and an oil boiler for DHW.

		Heating, ventila	tion and air con	ditioning systems		GREECE
Current system si 3		vling in a single system, independent E)HW]		
14	our heating and cool HEATING	ing demand				
[1] Cur	rent demand (k¥h/y	Entermanual ear) 0		Default Value	60000	
[2] Use	eful surface to heat (m2) 500]		
	ing emitter system			1		
[3] Sys	stem	Heat Pump Select] Default Value		
[4] Ene	ergy label	B] 4		
[5] Typ	e of equipment	Select Air Conditionir	ng]		
[5.1] T	jpe of equipment	Fan Coils]		
[5.1] S	jstem	dividual split type equipment (i	ndividual and bloc]		
[6] SC	OP]	3.4	
[7] Co	olant used	Other]		
🇱 COOLING						
[1] Current co	<i>En</i> ooling demand (k¥hł	ter manual	Default Value	900		
[2] Useful su	rface to cool (m2)	90]			
Select the cooling em	nitter system					
					[4] Fan	No
[3.1] Energy I	abel	В]		[4.1] Type of fan	Ceiling Default Value
[3.2] Type of	equipment	Air Conditioning]		[4.2] Energy consumption per hour	0.5
[3.3] Type of	equipment	Fan Coils]		[4.3] Hours of use per year	Default Value 900 hiyear
[3.4] SEER			5.1		[4.4] Number of fans	0
[3.5] Coolant	t used	Other]			
[3.6] Cooling	Consumption k¥h/Yea	r) 376.18]		[4.5] Total energy consumption of	fans 0 kWh/year
Ener	gy Consumption (k¥hłY	'ear)		28839.	17	
CO2	Emissions (gCO2 eq)			17303.504	19	

Figure 116. Heat pump system for heating and cooling in Nisyros



ACS Is there	a DH₩ system?	Yes		
Type of DH¥ heater	Boiler			
Type of Drive neater	Joller		Elefault Value	
Domestic Hot Water Demand (DH)	/) k¥h/sear		1919.413	
If the value is unknown:	,,,,,,,,			
Type of facility		Offices	N ^e workers	50
			Default Value	
Unit DH¥ consumption (I/day)			100	
			Default Value	
Cold Water Temperature ("C)			14.67	
[1.1] Type of boiler [1.2] Fuel [1.3] Litres of fuel (L)	Estándar Gasoil	 Default Value 190.17	79	
[1.3] Kg of fuel (kg) - Pellets/Bio		0.000		
[1.4] Energy label	В	_		
[1.5] Performance	90%			
[6] Direct use or DH¥ tank?	Direct Use			
DH¥ Consumption (k¥hł) CO2 Emissions (gCO2 eq)	-			1892.701248 497.4018879

Figure 117. Preliminary DHW system at Nisyros

Afterwards, the new heat pump data is introduced, but using geothermal energy.

• HEATING			[3.1]Type of boiler	Estándar
Select the heating emitter system			[3.2] Fuel	Electricity
[3] System [4] Energy label [5] Type of equipment [5.1] Type of equipment	Heat Pump Select A++ Select Geothermal energy closed loop (vertical) Fan Colls] Default Value A	[3.4] Energy label [3.5] Performance	Default Value
[6] SCOP	T an Colls]	5.1	
Heating Demand (kVh/Y CO2 Emissions (gCO2 e			2492.52 1495.51	
Select the cooling emitter system				
		Default Value	[4] ¥entilador	No
[3.1] Energy label [3.2] Type of equipment	A++ Geothermal energy closed loop (vertical)] 4	[4.1] Type of fan [4.2] Energy consumptio	Default Valu
[3.3] Type of equipment	Fan Coils]	[4.3] Hours of use per	
[3.4] SEER [3.6] Cooling Demand (k\h/Year	224.58] <i>8.5</i>]	[4.4] Number of fans [4.5] Total energy cons	0 umption of fans 0 kWh/year
Cooling Demand (k∀h/Y	ear)		224.58	

Figure 118. New heating, cooling and DHW system in Nisyros



ACS			
Type of DH¥ heater	Heater		
HEATER			
[2.1] Energy label	A]	
[2.2] Type of equipment	Geothermal energy closed loop (vertical)]	
[2.4] SCOP		4	
Heating Demand (k∀h/	Year)		3123.756714
CO2 Emissions (gCO2	eq)		1673.993402

Figure 119. New heating, cooling and DHW system in Nisyros

Finally, the energy and emissions mitigation balance are as follows.

Heating, ventilation and air con	ditioning systems
Select the option that best suits your current system : 3 Heating and cooling in a single system, independent DHW	
Click on the number that corresponds to the chosen option:	34
Energy Consumption k¥hłYear)	30731.87
CO2 Emissions (gCO2 eq)	17800.906
NEV	V SYSTEM
Please select the type of system to be used 4 Heating, DHW and cooling in one system	
Click on the number that corresponds to the chosen option:	34
Energy Consumption (k¥hłYear) CO2 Emissions (gCO2 eq)	3123.76

Figure 120. Energy savings and mitigation of air conditioning emissions in Nisyros

• Introduction of renewable energies in public buildings

Finally, it is proposed to introduce photovoltaic solar energy to provide electricity to public buildings.



PHOTOVOLTAIC	Solar Energy System		r storage? <mark>NO</mark> compensation
Building energy consumption	5475	5	
		Default Value	Default Value
Types of solar collector	Monocrystalline Performance	2) 0.23 Collect	tor size (¥) 100 200
Power generated (kWh)	19282.89525	Numbe	r of collectors 3 1
Battery capacity (Ah)	0		
Stored Energy (k¥h)			
Energy savings (k¥h/Year)		13807.90	
CO2 emissions saved per year (kg	CO2 eq)	8284.737	1 ŽŽ

Figure 121. Implementation of photovoltaic solar energy in Nisyros

• Replacement of vehicles with electric vehicles

Finally, the possibility of replacing a conventional municipal vehicle with an electric one is also being considered.

Number of vehicles withdrawn	1		
Average travel distance per vehicle per year		Default Value 16.5	CO2 emissions per vehicle per country (kgCO2/year)
		Default Value	
Electricity consumption of a EV		0.2	
No. of new electric vehicles	1		CO2 emissions per vehicle
			per country (kgCO2/year)
			per country (kgCU2rgear)

Figure 122. Introduction of municipal electric vehicles in Nisyros

G Transport

• Construction of cycling lanes

In the field of transportation, measures are proposed to use bicycles and promote transport from the municipal level. Therefore, the creation of a bicycle lane is also proposed.



ର୍ତ୍ତ	Cycling Routes	LOCATION GREECE
	Inhabitants	
[1] Number of inhabitants in the municipality		
[2] Distance of built-up cycleway	5	
[3] gCO2 emissions generated	1291.66	
[4] gCO2 emissions saved	3194495.707	
Energy saving (kW		0.000
CO2 emissions sav	red per year (kgCO2 eq)	3193204.047

Figure 123. Implementation of bicycle lane in Nisyros

• Promotion of public transport

Another measure in relation to public transportation is to increase the frequency of transit, thus encouraging its use and reducing emissions.

	Promoting public transport				
Please select the measures applied in the promotion of public transport:					
	Share CO2 savings	Apply	Emissions saved by municipality (kg of carbon dioxide)		
Reduced Speed Zones	25%		0.00		
Increase in the frequency of PT passage	10%	x	0.09		
Reducing fees for Youth and Pensioners	596		0.00		
Ecozone (ZBE)	97%		0.00		
Tolls (depending on rush hour or not)	30%		0.00		
Congestion charging (reducing the number of cars entering the city	20%		0.00		
		TOTAL	0.09]	
	:nergético (kWh/Año) es CO2 ahorrada al año (kg(CO2 eq)		0.000	

Figure 124. Promotion of public transport in Nisyros

G Awareness

The promotion of awareness-raising measures is essential to help the population become aware, get involved and reduce their energy consumption. For this reason, the municipality of Nisyros places special emphasis on taking environmental awareness measures.



		Information stands
\checkmark	Select the activ	ons you plan to implement in your municipality
1	Communication, training and a v areness-raising plan	Apply X
2	Environmental school for school groups	×
3	Collection of special vaste at Clean Points (recycling centres)	×
4	Bonuses for self-consumption:	
	IBI (property and real estate tax)	
	ICIO (Construction and works tax)	
	IAE (Business Activity Tax)	
	Municipal Fees	
5	Responsible energy consumption strategies	X
	Energy saving (kVh/Year) CO2 emissions saved per	

Figure 125. Citizen awareness measures in Nisyros

3.3.4.3. Multicriteria Decision in Nisyros

Considering the priorities established by the municipality, the criteria used to prioritize the different levels are as follows:

- Local production of electricity from renewable sources.
- Raising public awareness to reduce energy consumption at the municipal level, as well as reducing the use of oil.
- Improvement of the transport sector by reducing CO₂ emissions.

The assessments are introduced in the chosen software applying the AHP method and a final report is obtained, suitable for the municipality of Nisyros.

Alternative Rankings

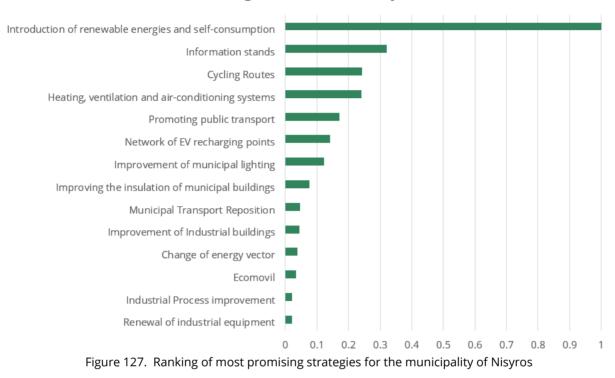
Graphic	Alternatives	Total	Normal	Ideal	Ranking
	CA1.1 Improving the insulation of municipal buildings		0.0303	0.0763	8
	CA1.2 Improvement of municipal lighting		0.0484	0.1218	7
	CA1.3 Heating, ventilation and air-conditioning systems		0.0953	0.2400	4
	CA1.4 Introduction of renewable energies and self-consumption	0.1317	0.3969	1.0000	1
	CA1.5 Municipal Transport Reposition	0.0060	0.0181	0.0456	9
	CA2.1 Industrial Process improvement	0.0029	0.0087	0.0219	13
	CA2.2 Renewal of industrial equipment	0.0027	0.0081	0.0204	14
	CA2.3 Improvement of Industrial buildings	0.0059	0.0178	0.0449	10
	CA2.4 Change of energy vector	0.0049	0.0149	0.0375	11
	CA3.1 Cycling Routes	0.0320	0.0966	0.2433	3
	CA3.2 Network of EV recharging points	0.0185	0.0559	0.1408	6
	CA3.3 Promoting public transport	0.0226	0.0682	0.1718	5
	CA4.1 Ecomovil	0.0045	0.0135	0.0341	12
	CA4.2 Information stands	0.0422	0.1273	0.3208	2

Figure 126. Report on alternatives obtained for the municipality of Nisyros



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Finally, the ranking of the most valued alternatives taking into account the municipal casuistry is as follows:



Ranking of measures in Nisyros

3.3.4.4. Ranking of the most promising strategies in Nisyros

In summary, the most promising strategies for the municipality of Nisyros are presented. A table with the results obtained by implementing the GENERA tools is presented below:

PRIORITY	ACTION	ENERGY SAVINGS (MWh/year)	CO₂ SAVINGS (tCO₂e)	CATEGORY
1	Introduction of renewable energies and self-consumption	13.87	8.28	Municipal facilities
2	Information stands	0.73	2.81	Awareness
3	Cycling Routes	-	3.19	Transport
4	Heating, ventilation and air-conditioning systems	27.6	16.13	Municipal facilities
5	Promoting public transport	-	0.09	Transport
6	Network of EV recharging points	-	724.16	Transport
7	Improvement of municipal lighting	8.79	5.27	Municipal facilities
8	Improving the insulation of municipal buildings	_	-	Municipal facilities

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PRIORITY	ACTION		ENERGY SAVINGS (MWh/year)	CO ₂ SAVINGS (tCO ₂ e)	CATEGORY
9	Municipal Transport Reposition		-	0.54	Municipal facilities
10	Improvement of Industrial buildings		-	-	Industry
11	Change of energy vector		-	-	Industry
12	Ecomovil		-	-	Awareness
13	Industrial Process improvement		-	-	Industry
14	Renewal of industrial equipment		-	-	Industry
		TOTAL	50.99	760.47	

Table 13. Most promising strategies in Nisyros and estimated associated energy and emissions reductions

The most promising strategies for Nisyros focus mainly on improving municipal facilities, public awareness and transportation. Therefore, its main actions are awareness-raising, although it is also betting on local energy generation and energy efficiency.



3.4. Lessons Learned

This section introduces some ideas that have been compiled for each of the GENERA modules in order to improve the tool and make it more user-friendly for policy makers.

- G Improvements in the Energy Planning Module:
 - It is proposed the possibility of introducing a national scenario based on the results and measures integrated in the municipalities and resulting in a more sustainable scenario.
 - Facilitate the input data to the tool, as the process can be complicated, e.g., searching for data in the International Energy Agency.
- G Improvements in the Inference Module:
 - In this case, since these are pilots, standard measures have been implemented (municipal buildings in general), but it is proposed the possibility of introducing measures for each specific building and finally obtain the sum of energy savings and emissions.
 - The possibility of adding local energy generation actions is raised, studying better the different alternatives proposed by other municipalities and plans.
 - It is suggested to provide a method of data entry (units, how calculations are performed, etc.) to reduce time for unit changes and other needs that arise when entering information into the tool.
 - Specific improvement in energy efficiency in buildings: introduce measures targeting private buildings, as public buildings are considered to have mainly a direct impact. However, the option of private houses could be introduced, including a lower success rate.
 - It is important to introduce the idea of generating electricity at the level of energy community and housing supply, as it is proposed for public buildings but also for housing and energy communities.
 - In relation to the general structure of the tool, the option of dividing the measures into mitigation and adaptation in accordance with the guidelines of the Covenant of Mayors is proposed.
- G Improvements in the **Decision Module**:
 - It is indicated that the time required to enter the information is high, so some simplification is appropriate.
 - It is important to reduce the number of indicators, as many indicate similar values or options (percentage of municipal RE and municipal RE production, etc.), which slows down the decision-making process.



- The possibility of implementing the AHP method in an alternative tool that allows the introduction of comparisons in a more dynamic way, as well as making changes in a more agile way, is studied. The use of the SuperDecisions software is a tedious computational process that requires a well-functioning computer.
- A proposal to improve the module is to activate and deactivate those actions not included in the municipal plans, since even though they are not included, they are assigned weights by comparison with other strategies. In this case, since there were not many actions included, although the process was tedious, it was feasible, but in the case of introducing many actions, the calculation time can be very long.

Overall, the results obtained are in line with expectations. This is the first version of the GENERA tool that includes three calculation modules together with the database of municipal actions. It is possible to introduce improvements and include options proposed in this document to achieve better results.



4. Conclusions

This section compiles the conclusions obtained after the completion of this deliverable, as well as of WP3 on the development of an energy transition tool aimed at municipalities and political decision-makers in the islands in particular.

After identifying a clear need to create tools aimed at municipalities to assist them in the creation of an action plan, GENERA has created a tool consisting of different modules that provides information at the national level and deepens not only at the local level, but also at the particular level of the current governance team. The possibility of including qualitative information provides a tool tailored to smaller municipalities.

The broad scope of the GENERA tool requires the management of many data: national (energy context), regional (municipal) and local (governance team). This gives very precise information about the context in which the municipality is framed and can help policy makers to have an overview of where the municipality wants to go with its measures.

The GENERA tool created and implemented in these pilots are intended to be userfriendly and easy to use, although improvements can still be implemented to facilitate their use and information visibility (see section on lessons learned). In addition, the idea of creating a manual to facilitate their use could also be considered.

This document is current evidence that a tool with these characteristics can be very useful for any policy maker, simple to use and with easily manageable information. The results provided are technically easy to understand and can be modified. It should be noted that these pilots could be more extensive and include an infinity of actions, but due to the limit of content it was decided to carry out a limited pilot per municipality, since the idea was to test its operation and results.

In essence, through the GENERA project, a tool has been created consisting of different modules that provide information on the ET status of different municipalities. This tool is specifically created to be applied in municipalities located in the countries of the project consortium (Greece, Italy and Spain). A pilot test has been carried out in different municipalities of tourist islands: Sant Antoni de Portmany (Ibiza, Spain), El Rosario (Tenerife, Spain), Stintino (Sardinia, Italy), Halki, Rhodes and Nisyros (Greece). From each of the pilots, a list of measures has been obtained according to the municipal casuistry and municipal needs, and energy savings and CO₂ emission reductions have been obtained. It is expected to improve and complete the action plans of these municipalities, collecting more information and applying it to other municipalities to continue progressing in the development of this tool.



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